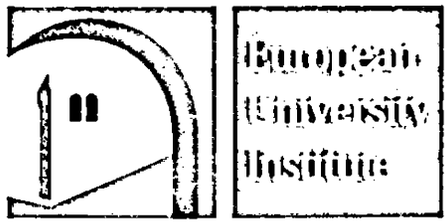

Department of Political and Social Sciences

Alternative Pathways to Competitiveness within Developed Capitalism
A Comparative Study of the Pharmaceutical Sector in Germany, Italy and the UK

by
Andrea Herrmann

Thesis submitted for assessment with
a view to obtaining the degree of Doctor of the
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Florence, 22nd June 2006

LIST OF ABBREVIATIONS

BSI	British Standards Institution
CME	Coordinated Market Economy
DIN	Deutsches Institut für Normung
DQP	Diversified Quality Production
DQPs	Diversified Quality Producers (i.e. firms which pursue a DQP strategy)
EMEA	European Medicines Agency
GMP	Good Manufacturing Practice
HR	Human Resources
IPO	Initial Public Offering
LCP	Low Cost Production
LCPs	Low Cost Producers (i.e. firms which pursue an LCP strategy)
LME	Liberal Market Economy
NCE	New Chemical Entity
OE	Organisational Economics
PHID	Pharmaceutical Industry Database
PRO	Public Research Organisation
QCA	Qualitative Comparative Analysis
R&D	Research and Development
RPI	Radical Product Innovation
RPIs	Radical Product Innovators (i.e. firms which pursue an RPI strategy)
SME	Small and Medium Enterprise
VoC	Varieties of Capitalism

ABSTRACT

The present research project questions the central argument of the literature on competitiveness: that firms in the same economy specialise in the same competitive strategy (Heckscher 1919; Ohlin 1933; Sinn 2005; Lundvall 1992; Nelson 1993; Porter 1990; Hall and Soskice 2001). Given that national institutions provide one set of input factors, as required for one specific competitive strategy, this body of literature expects firms to exploit such institutional advantages by pursuing the institutionally favoured strategy. Contrary to these expectations, my analysis of the pharmaceutical sector shows that firms in Germany, Italy and the UK pursue (1) a *radical-innovation-*, (2) a *high-quality-*, and (3) a *low-cost- strategy* to the same extent.

Aiming at understanding how firms can pursue different strategies within the same institutional environment, my research project explores the link between (national) institutions, input factors and competitive strategies. In so doing, I first test whether the competitiveness literature rightly suggests that each competitive strategy requires a specific set of input factors. Finding this hypothesis to hold true, I then analyse how firms secure required factors in diverse institutional environments. Exploring different institutional pathways to firm competitiveness, I show that the competitiveness literature falls short in its overly narrow focus on *national* institutions: The literature simply ignores the fact that firms secure input factors not only through national institutions, but also through *'improvisation' on a contractual basis*, and through *'importation' by drawing on international institutions*.

This finding has two implications. Firstly, given the variety of institutions on which firm competitiveness is based, national institutions do not assume their shape with the aim of supporting one specific production regime. Hence, I retain a historical account more useful to explain institutional development than the functionalist explanations proposed in the competitiveness literature. Secondly, the inventiveness of entrepreneurs in securing required input factors indicates that they are Schumpeterian innovators rather than institutionally constrained actors. Accordingly, a Schumpeterian perception of entrepreneurs is more instructive for understanding how firms gain international competitiveness than the approach of the competitiveness literature, which perceives entrepreneurs as mere institution-takers. These insights lead me to conclude that the increasing internationalisation of economic affairs entails *divergence in the shape of institutions*, and *convergence in entrepreneurial practices*.

1. THE PUZZLE*

> The mathematician Stanislaw Ulam once challenged nobel laureate Paul Samuelson: "Name me one proposition in all of the social sciences which is both true and non-trivial." It was some thirty years later that Samuelson arrived at an answer which was appropriate in his view: *The theory of comparative advantage*. "That it is logically true need not be argued before a mathematician; that is not trivial is attested by the thousands of important and intelligent men who have never been able to grasp the doctrine for themselves or to believe it after it was explained to them." (Samuelson 1969: 9)

1.1. ONE POLITICAL ECONOMY, ONE COMPETITIVE STRATEGY?

The idea that different competitive strategies require different input factors will hardly strike anyone who has ever contemplated firms' international competitiveness as peculiar. To date, a broad body of literature exists which studies how diverse input factors impact competitive strategies, and how these factors are provided by national institutions. This literature ranges from early neoclassical trade theory (Heckscher 1919; Ohlin 1933) to strands of modern neoliberal theory (Sinn 2005); it includes strands of strategic management literature (Porter 1990; Porter 1985), as well as the literature on 'national innovation systems' (Lundvall 1992b; Nelson 1993; Hollingsworth 2000) and on 'varieties of capitalism' (Hall and Soskice 2001b). In the following, I will address and summarise this literature as 'competitiveness literature'.[1]

In essence, the competitiveness literature distinguishes between three competitive strategies, namely *Radical Product Innovation* (henceforth RPI)[2], *Diversified Quality Production* (henceforth DQP)[3], and *Low Cost Production* (henceforth LCP)[4] (see e.g. Ohlin 1933: 7; Sinn

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* I gratefully acknowledge the assistance of Laura Magazzini in sampling the PHID database. Without her help, I would have been unable to select the case sample, presented in this chapter, in a consistent way.

[1] It should be noted that another broad body of literature exists which studies how *sub-national* institutions provide the input factors required for diverse competitive strategies. In essence, this literature includes studies of regional (Saxenian 1996; Cooke, Gomez Uranga, and Etxebarria 1997; Malmberg and Maskell 1997) and sectoral innovation systems (Carlsson and Stankiewicz 1991; Breschi and Malerba 1997), as well as the literature on industrial districts (Piore and Sabel 1984; Pyke, Becattini, and Sengenberger 1990; Pyke and Sengenberger 1992) and local production systems (Crouch and Trigilia 2001; Crouch, Le Gales, Trigilia, and Voelzkow 2004). However, contrary to the above-named competitiveness literature, these studies are compatible with the view that firms in the same economy pursue different competitive strategies. Accordingly, the findings of this research project cannot contribute to the latter body of literature, which I therefore exclude from all following considerations.

[2] In line with the conceptual approaches proposed in the competitiveness literature (Lundvall 1992b: 11-12; 58-59; Hall and Soskice 2001a: 38-39; Estevez-Abe et al. 2001: 149; 174; Casper 2001: 398), I define an RPI strategy as the competitive effort of a firm which leads to the market launch of a *hitherto unknown product*, being the result of a *radical technological innovation.*

[3] In line with the conceptual approaches proposed in the competitiveness literature (Lundvall 1992b: 11-12; 57-58; Hall and Soskice 2001a: 39; Estevez-Abe et al. 2001: 148-149; 174; Casper 2001: 399-400), I understand a DQP

2005: 18-19; Lundvall 1992b: 11-12; 57-59; Freeman 1992: 182; Porter 1990: 10; 37; Hall and Soskice 2001a: 38-39; Estevez-Abe, Iversen, and Soskice 2001: 148-149; 174-175; Casper 2001: 398-400). Interestingly, the pursuit of each strategy is found to require very specific input factors: To pursue an RPI strategy, based on a radical technological innovation, firms are said to require employees with high but rather general skills (Estevez-Abe et al. 2001: 174; Hall and Soskice 2001a: 40-41; see Freeman 1992: 170-171; 182; Ohlin 1933: 51), 'short' finance 'for risky undertakings' (Ohlin 1933: 55; Hall and Soskice 2001a: 40; Vitols 2001: 350-351; see Lindgaard Christensen 1992: 153; 162-163), and competitive standardisation processes (Hall and Soskice 2001a: 31-32; Tate 2001: 445; 468; see Lundvall 1992c: 58). The pursuit of a DQP strategy, which is based on incremental technological innovation, is found to rely on employees with high and firm-specific skills (Estevez-Abe et al. 2001: 174; Hall and Soskice 2001a: 39-40; see Porter 1985: 127-128; Freeman 1992: 170-171; 182; Ohlin 1933: 51), on 'long' finance 'for safe investments' (Ohlin 1933: 55; Hall and Soskice 2001a: 39-40; Vitols 2001: 351-352; see Lindgaard Christensen 1992: 153; 160-161), and on cooperative standardisation processes (Hall and Soskice 2001a: 26-27; Tate 2001: 445-446; see Lundvall 1992c: 57-58). Finally, firms that wish to pursue an LCP strategy of technological imitation are said to require cheap input factors, and most importantly an unskilled and, consequently, low-cost labour force (see Ohlin 1933: 7; 51-54; Sinn 2005: 18-19; Porter 1985: 127-128; Hall and Soskice 2001a: 44; Estevez-Abe et al. 2001: 175).

Interestingly, the competitiveness literature also argues that firms in each developed capitalist economy are provided with one specific set of input factors, depending on the economy's institutional arrangements. With regard to the latter, the literature broadly distinguishes between two types of economies - those with *flexible market regulation* on the one hand, and those with *rigid market regulation* on the other (Hall and Soskice 2001b; Sinn 2005; see Hollingsworth 2000; Freeman 1992; Lindgaard Christensen 1992; Ohlin 1933: 52-56). In *flexible regulation economies*, the interaction between firms and their employees, financiers and suppliers is said to be essentially organised by the market. Thus, a flexible labour market allows firms to hire and fire employees according to their changing needs (Hall and Soskice 2001a: 29-30; see Estevez-Abe et al. 2001: 150-155; Ohlin 1933: 52-53). Deregulated financial markets enable firms to attract shareholders in accordance with their short-term stock market performance

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strategy to be the competitive effort of a firm which leads to the market launch of a *hitherto known but improved product*, being the result of an *incremental technological innovation*.

[4] In line with the conceptual approaches proposed in the competitiveness literature (Ohlin 1933: 7; Sinn 2005: 18-19; Porter 1990: 10; 37; Estevez-Abe et al. 2001: 148; 175; Casper 2001: 398-399), I define an LCP strategy as the competitive effort of a firm which leads to the market launch of a standardised product, resulting from the *imitation of an established technology*.

(see Hall and Soskice 2001a: 27-29; Vitols 2001; Ohlin 1933: 55-56). In addition, restrictive competition law and anti-trust regulations guarantee firms that, whenever a radically new product is launched, that with the most competitive standard will win the market-race (Tate 2001: 443-444; Hall and Soskice 2001a: 31; see Teubner 2001: 433-435). Such flexible, or short-term oriented, regulation is said to provide firms with generally skilled employees, short-term finance, and competitive standardisation processes – exactly those input factors required for an RPI strategy.

The opposite holds true for *rigid market economies*, where rigid market regulation means that interaction between firms and their employees, financiers, and suppliers is often channelled by cooperative institutions rather than the market. Hence, a rigid labour market is not only the result of powerful trade unions, obstructing hiring and firing at short notice. It also supports collaboration between unions and employer associations in negotiating industry-wide pay levels and vocational training programs (Hall and Soskice 2001a: 24-26; see Estevez-Abe et al. 2001: 150-155; Ohlin 1933: 52-53). Similarly, the strong say of shareholders in major corporate decisions makes the former less susceptible to selling their shares in accordance with the firm's short-term stock market performance. Instead, shareholders often hold stocks and, hence, provide 'patient' finance even in times of economic downturn (Hall and Soskice 2001a: 22-24; Vitols 2001; see Ohlin 1933: 55-56). Finally, permissive competition law and anti-trust regulations enable large-scale cooperation between suppliers and producers which, in turn, facilitates cooperative standardisation processes (Tate 2001: 443; Teubner 2001: 433-434). In sum, long-term oriented market regulation is found to promote cooperation between firms and their most important interlocutors which, in turn, leads to the provision of those input factors required for a DQP strategy.

If we accept that these claims of the competitiveness literature hold true, a remarkable conclusion may be drawn. If firms need a specific set of input factors to pursue a specific competitive strategy, and if the institutions of an economy actually provide just one set of factors, then firms within the same economy should specialise in the pursuit of the same strategy (see Heckscher 1919; Ohlin 1933; Sinn 2005; Porter 1990; Freeman 1992; Lindgaard Christensen 1992; Nelson 1993; Hollingsworth 2000: 626-630; see in particular Hall and Soskice 2001a: 38-44; Estevez-Abe et al. 2001: 174-176; Vitols 2001: 350-360; Tate 2001: 442-455). It is important to note that the competitiveness literature empirically grounds this claim on macro-level data. Hence, the *technology intensity of entire* ***industries*** is taken as a proxy to measure competitive strategy (Dalum 1992; Fagerberg 1992; Nelson 1993; Porter 1990: 179-541; Hall and Soskice 2001a: 41-44). Accordingly, the finding that specific (high- or low-tech) industries are more

developed in some economies than in others is cited as empirical proof of the idea that firms in respective economies specialise in the same (high- or low-innovation) strategies. Yet this approach is grounded on the assumption that all firms within the same industry pursue the same competitive strategy.

Interestingly, the strategy-specialisation argument of the competitiveness literature has, to date, not been tested on the basis of micro-level data. This is noteworthy to the extent that one can well imagine firms to pursue different competitive strategies within the same industry. Hence, the question arises whether empirical evidence still supports the claim that *firms* in the same economy pursue the same competitive strategy, if the *technology intensity of firms* is used as a proxy for competitive strategy. It will be the aim of the remaining chapter to shed light on this question.

1.2. Operationalising the Notion of Competitive Strategy

So, how can we measure *at the micro-level* whether firms in the same economy pursue the same competitive strategy? In other words, how can we operationalise the notion of competitive strategy so as to determine whether a firm pursues an RPI, a DQP, or an LCP strategy? To this end, the Abernathy-Utterback model is very instructive (see Utterback 1994). In order to describe how technological innovations impact upon industries, Abernathy and Utterback introduce the concept of a "dominant design". This concept makes it possible to distinguish between the emergence of radically new products, the improvement of already existing products, and the imitation of standardised goods.

"A dominant design usually takes the form of a new product synthesized from individual technological innovations introduced independently in prior product variants. [Hence], a dominant design has the effect of enforcing or encouraging standardization so that production or other complementary economies can be sought. [Once a dominant design has emerged], effective competition begins to take place on the basis of cost and scale as well as product performance." (Utterback 1994: xx). To give an example, when the first cars were invented, an impressive variety of technology existed with regard to their operation. In addition to fuel driven cars, steam and electric vehicles, as well as cars with an internal combustion engine were produced. At some point, however, fuel driven cars turned out to be the most efficient and, hence, emerged as the dominant design of what we, today, understand as 'a car' (Utterback 1994: 27-29). Importantly, Abernathy and Utterback (1994: 75-76; 83-84; 88) show that firms are not necessarily obliged to compete by producing radically or incrementally *new* products. Instead, they can opt to *imitate* existing goods with a view to selling them at the lowest possible price. In other words, instead of

proposing a new or improving an existing dominant design, a firm can simply imitate the latter. This, in turn, signigicantly reduces the product's retail price.

Let us apply the concept of 'dominant design' to the end of distinguishing between the three competitive strategies. To begin with, a firm can be said to pursue an RPI strategy if it competes by constantly inventing radically new products, i.e. products leading to a new dominant design. In contrast to this, a firm can be said to pursue a DQP strategy if it improves existing products by slightly modifying, although not substantially altering, the underlying dominant design. Accordingly, a firm pursues an LCP strategy if it does not change but merely imitates a dominant design so as to sell the respective product at the lowest possible price.

Abernathy and Utterback also show that technological innovations occur in waves. The latter are particularly distant in *traditional industries* (Utterback 1994: 131-132; 178). Once a product based on a new dominant design has emerged, it usually takes many years – if not decades – before the next radical product innovation is made. In other words, the number of firms successfully pursuing an RPI strategy is rather limited in traditional industries. This is different for the so-called *high-tech industries*. Since the latter are particularly technology-intensive, radically new products are invented more frequently. In order to determine the frequency with which firms in different economies pursue different competitive strategies, it is therefore useful to study a high-tech industry.

Amongst these, the drug industry seems particularly opportune for two reasons. Firstly, radical innovations are made frequently. With the decoding of the human genome, so vast technological opportunities to exploit this knowledge base commercially were opened that many firms began work on the development of not one, but several, new drugs at the same time. Hence, a comparatively high number of firms pursuing an RPI strategy can be found in this industry.

Secondly, the concept of dominant design can be applied in a particularly straight-forward manner to pharmaceutical firms with the aim of distinguishing between radical and incremental innovation, as well as imitation. New, i.e. patent-protected pharmaceutical products can take one of two forms. They may be radically new in that they are based on a New Chemical Entity (henceforth NCE), i.e. on a chemical entity which has not been discovered before. In other words, the resulting drug proposes a new dominant design (an NCE) for treating a disease. Alternatively, patent-protected drugs can be incrementally new in that they are *not* based on the discovery of an NCE. Instead, they are based on slight changes to already discovered chemical entities with the result that the drugs' efficiency is improved. Consequently, undesired side-effects are limited, or the frequency or quantity with which a drug has to be consumed is reduced. Such incrementally new drugs do not propose a new dominant design, but improve established designs by

introducing slight modifications to them (see Bottazzi, Dosi, Pammolli, and Riccaboni 2001: 1164). Yet not all drug producers engage in research and development activities on their own. A large number of (generics) firms compete by imitating a product's dominant design, as invented by a competitor, in order to sell the respective product at the lowest possible cost as soon as patent protection expires (see e.g. Wittner 2003).

I shall now apply these insights to differentiate between diverse competitive strategies in the pharmaceutical industry. To begin with, firms which compete by inventing drugs based on an NCE will be said to pursue an RPI strategy. On the other hand, firms that compete by improving already discovered chemical entities are held to pursue a DQP strategy. Finally, firms which do not engage in R&D, but focus on imitating innovations made by others, will be said to pursue an LCP strategy.

In the following section, I will use this operationalisation to determine the frequency with which pharmaceutical firms in different economies pursue different competitive strategies. Before doing so, it is useful to point out that one strand of the competitiveness literature, namely the 'varietites of capitalism' approach (Casper 1999b),(Casper 1999a; see also Casper, Lehrer, and Soskice 1999) has employed an alternative operationalisation of competitive strategies in the pharmaceutical industry. Focusing on the biotech segment, Casper suggests that firms developing *therapeutics* pursue an RPI strategy as this market segment is often characterised by radical innovation. On the other hand, the market segment of platform technologies is particularly susceptible to incremental innovation so that developers of *platform technologies* are said to pursue a DQP strategy. On the basis of this distinction, Capser finds that biotech firms in Germany have specialised in the development of platform technologies, i.e. in Diversified Quality Production, whereas firms in the UK have specialised in the development of therapeutics, i.e. in Radical Product Innovation.

Today, these specialisation patterns have almost disappeared (see Ernst&Young 2002), and they are most likely not a result of German and UK biotech firms' preferences to pursue just one competitive strategy. Instead, the abovementioned specialisation patterns seem to have resulted from a time-inconsistency problem, in that the German biotech industry is younger than its British counterpart. Thus, at the time of Casper's analysis, the German biotech industry was significantly less developed. It is well documented by the literature that the development of a new drug is extremely expensive. On average, it takes about 12 years before a pharmaceutical research project can be turned into a profitable drug (Gambardella, Orsenigo, and Pammolli 2001: 38; Grabowski and Vernon 1994: 438; Drews 1999: 186-190). This puts start-up firms under particular financial pressure because they cannot usually rely on retained earnings to finance their

highly expensive research project(s). In order to get through this financial drought, biotech firms, which ultimately aim at developing a therapeutic product, commercialise their knowledge by providing platform technologies to other companies. Yet this provision of platform technologies is usually a temporary means to secure finance, rather than a strategy in itself (Freyberg 2004). As a result, a 'young' biotech industry is characterised by a comparatively high number of firms providing platform technologies.

In addition to the time-inconsistency problem related to Casper's argument, his distinction between DQP and RPI falls short in two respects: Firstly, as Capser (Casper et al. 1999: 21) notices himself, "(...) platform-technology firms create the research tools used in therapeutics". Indeed, platform-technology firms do not provide molecules which can be used to target a disease. Instead, these firms (provide the knowledge to) synthesise proteins which, in turn, can be used as carriers for transporting other molecules. Thus, platform-technology companies are suppliers to therapeutics firms (Freyberg 2004). Hence, Casper compares two different *market segments*, rather than two different *competitive strategies*. As a corollary, the second problem of Casper's distinction between RPI and DQP is that he does not compare two secondary, i.e. two manufacturing sectors. Instead, he compares the *manufacturing sector* of therapeutics to the tertiary, i.e. the *service sector* of platform technologies. In sum, Capser compares two market segments which are presumably not comparable.

These flaws suggest that the approach to operationalisation proposed at the beginning of this section is more fruitful for identifying a firm's competitive strategy than the approach of Casper et al.. I will therefore use the former operationalisation in order to determine the frequency with which pharmaceutical companies in different economies pursue RPI, DQP, and LCP strategies. So, is it true that firms in the same political economy specialise in the same competitive strategy?

1.3. Identifying different Competitive Strategies in the Drug Industry[5]

1.3.1. The Division of Labour in the Drug Industry

The most comprehensive database allowing the identification of competitive strategies on the basis of (new) chemical entities is the Pharmaceutical Industry Database (henceforth PHID)[6].

[5] An overview of the sampling strategy developed in the present section is provided in the technical appendix.
[6] In addition to the PHID database, I also sampled the Pharmaprojects database in order to classify pharmaceutical firms with regard to their competitive strategies. However, the Pharmaprojects database did not allow me to identify whether a drug is based on an NCE. Comparing the sampling results of both databases, I found those of the PHID database more instructive for the purposes of distinguishing between different competitive strategies.

Developed by a group of researchers at the University of Siena, this database keeps track c 16751 pharmaceutical projects carried out by 3522 firms and public research organisations in countries (France, Germany, Italy, Japan, Switzerland, USA, UK)[7].[8] A firm is included in th PHID database if it is, or has been, involved in at least one pharmaceutical project which ha reached the stage of preclinical development since the 1980s. Thus, even those pharmaceutica projects that are/were not granted patent protection are included in the database. Furthermore pharmaceutical projects are considered only if they translate(d) into therapeutic drugs curing o alleviating human diseases. Pharmaceutical firms which are active in the service sector, such a platform-technology suppliers, are *only* included in the database if they (have) also develop(ed) a therapeutic product.

In order to understand the approach used for sampling the PHID database, it is important to note that the division of labour in the pharmaceutical industry is pronounced (see Gambardella et al. 2001: 36-53). Any drug which is sold on the market must have passed through three major stages. The first one is the *research stage* (drug discovery and preclinical development) during which a firm discovers how a chemical entity interacts with other molecules in such a way that a curative effect can be obtained. The second, *development stage* consists in turning this discovery into a pharmaceutical product. During the so-called phases of 'clinical development I, II and III', a firm experiments under which form and in which dosage the pharmaceutical product should be administered. Furthermore, undesired side effects are recorded and, if possible, reduced or eliminated. Finally, any relevant information with regard to both the drug's features and its production process are documented in the third, *registration stage*. This documentation is then handed to the responsible national or international authorities in order to obtain a marketing authorisation (see Drews 1999: 117-154).

The Italian researchers administering the PHID database show that the three abovementioned stages are often not carried out by the same firm. Instead, pharmaceutical companies tend to specialise in one of these stages (see Orsenigo, Pammolli, and Riccaboni 2001; Bottazzi et al. 2001; Owen-Smith, Riccaboni, Pammolli, and Powell 2002; Magazzini, Orsenigo, and Pammolli 2002). Interestingly, it is shown that labour division is not only pronounced between innovative pharmaceutical firms on the one hand, and generics firms on the other (see Magazzini et al. 2002). Labour division is also pronounced among innovative firms (see Orsenigo et al. 2001; Bottazzi et al. 2001; Owen-Smith et al. 2002). To shed light on the division of labour in the research and development phases of a pharmaceutical project, the Italian researchers

[7] To be precise, the PHID database covers 67 countries. However, the number of pharmaceutical projects considered in the other 60 countries are too few to provide representative results.

distinguish between *developers*, *licensors* and *licensees*. A *developer* is a firm with a fully integrated value chain that carries out all stages on its own. In other words, a drug is discovered, developed and registered by the same firm. A *licensor*, on the other hand, initiates a project which ultimately translates into a new drug. However, by focusing on the research stage (i.e. on discovery and preclinical development), the licensor decides at a certain point to licence its discovery to another firm, which continues the clinical development and registration process. Accordingly, a *licensee* focuses on the stages of (late) clinical development and registration in order to translate the respective discovery into a marketable drug. On the basis of this distinction, the Italian researchers show that biotech firms tend to be licensors, whereas traditional pharmaceutical firms are often licensees (Orsenigo et al. 2001).

In order to obtain a better understanding of this labour division, it is useful to discuss briefly the differences between *a pharmaceutical firm*, a *traditional pharmaceutical firm*, a *biotech firm* and a *generics firm*. The term 'pharmaceutical firm' is commonly used to assign a firm to an industry on the basis of the *product* which it manufactures, namely a drug that cures or alleviates a disease. The term 'biotechnology firm', instead, assigns a firm to an industry on the basis of the *technological approach* which it employs. Generally, the term 'biotechnology' describes any technology which uses processes on the level of the cell and sub-cell to create industrially useful substances. Accordingly, the literature distinguishes between *green biotechnology*, *grey biotechnology*, and *red biotechnology*[9]. Since this research project only considers firms active in the 'red' drug industry, all studied biotechnology firms are at the same time pharmaceutical firms. In a similar vein, all pharmaceutical firms are aware of biotechnological opportunities to discover and develop drugs[10]. Thus, the drugs produced by pharmaceutical firms are often based on biotechnological approaches. Yet drug firms differ in the extent to which they rely on biotechnology in the research, development, and manufacturing process of a pharmaceutical product.

Accordingly, I propose the following definitions in order to distinguish between different types of firms active in the drug industry. I define a *pharmaceutical firm* as any firm which discovers, develops, produces, sells or markets a pharmaceutical product curing or alleviating a human disease. A *traditional pharmaceutical firm*, instead, is a pharmaceutical firm which uses

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[8] Since this database is constantly updated, these figures refer to November 2004.

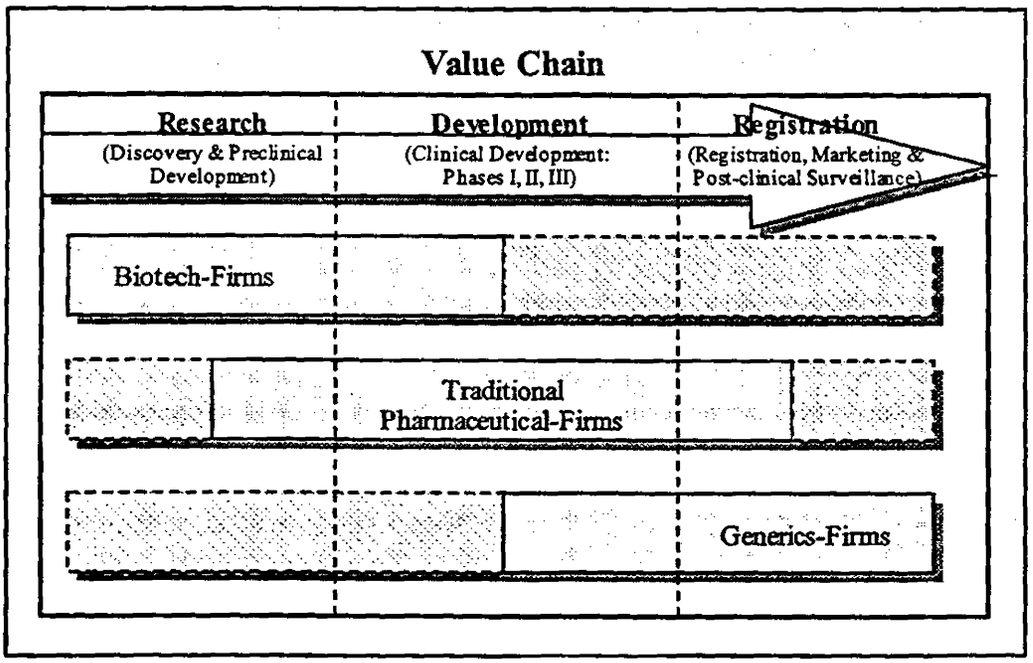
[9] Whilst green biotechnology aims at creating industrially useful substances in the field of agriculture, *grey biotechnology* seeks to do so in the field of ecology. *Red biotechnology*, in turn, aims at creating industrially useful substances in the pharmaceutical area.

[10] As Casper et al. (Casper and Matraves 1997: 5) note, '[i]n the pharmaceutical industry, biotechnology is used in 3 different ways: i) to produce drugs and vaccines using rDNA technology; ii) to make intelligent screens for new compounds; and iii) to apply techniques for rational drug design by understanding molecular structure.'

the more traditional techniques in the research, development, and production process of a pharmaceutical product. In contrast, I refer to a *biotech firm* as a pharmaceutical firm which relies on biotechnology in order to discover, develop or produce a drug. Finally, a *generics firm* is understood as a firm that does not engage in any sort of research and clinical development activities, but merely imitates drugs as soon as their patent protection expires.

That said, let us turn back to the findings of the aforementioned group of Italian researchers. As pointed out previously, the latter show that labour division in the pharmaceutical industry is pronounced. Graph 1.1. provides an overview of this phenomenon.

Graph 1.1.: Labour Division in the Drug-Industry



Source: Own illustration based on the work of Magazzini et al. (2002), Orsenigo et al. (2001) and Gambardella et al. (2000)

The distinction between a developer, a licensor and a licensee is very useful for the purpose of distinguishing between different competitive strategies. In order to sample the PHID database in a coherent way, I made the following distinctions:

- A firm is pursuing an RPI strategy if it is the *developer* or the *licensor* of a pharmaceutical project which translates into a drug based on an NCE. Since the discovery of the NCE is made by the licensor, the latter is ***radically innovative*** in that it proposes the dominant design of the resulting product. Hence, it does not matter whether the agreement is made at the development or the registration stage of a pharmaceutical project.

- Following this logic, a firm pursues a DQP strategy if it is the *developer* or *licensor* of a pharmaceutical project which improves a previously discovered chemical entity. Furthermore, a firm can also be said to pursue a DQP strategy if it *in-licences* a pharmaceutical project based on an NCE *at the stage of clinical development.* At that moment, the hitherto unknown chemical entity has already been discovered. Accordingly, it is the main task of the licensee to improve the known chemical entity in such a way as to optimise its effectiveness and dosage. Hence, a licensee which develops a pharmaceutical project, translating into an *improved* chemical entity, can also be said to pursue a DQP strategy. In sum, both licensees of a clinical development agreement, and developers or licensors of an improved drug pursue a DQP strategy in that they are not radically but merely ***incrementally innovative.***
- This leaves us with a third group of firms consisting of those companies that conclude agreements with the purpose of registering and marketing both radically or incrementally new drugs. Interestingly, these firms concur with generics firms in that both abstain from engaging in any sort of expensive research and development activities. Instead, their strategy consists in producing and selling drugs at the ***lowest possible costs.***

1.3.2. RPI, DQP AND LCP IN THE UK, GERMANY AND ITALY

So, to what extent do pharmaceutical firms in different political economies vary with regard to the competitive strategies they pursue? Sampling the PHID database according to the abovementioned criteria allows us to distinguish between radically innovative firms (Radical Product Innovators), incrementally innovative firms (Diversified Quality Producers), and non-innovative firms (Low Cost Producers).

To this end, it is sufficient to limit the firm sample to Germany, the UK and Italy. Of the seven countries covered by the PHID database, Germany and the UK are the two European states which the competitiveness literature in general, and the literature on 'varieties of capitalism' in particular, claim to be ideal-typical economies, respectively of rigid and flexible market regulation (Hall and Soskice 2001b; Hollingsworth 2000; Sinn 2005; see Freeman 1992; Lindgaard Christensen 1992; Porter 1990: 355-382; 482-507). Hence, firms in Germany are said to specialise in the pursuit of a DQP strategy, whereas firms in the UK are held to specialise in Radical Product Innovation (Hall and Soskice 2001a: 38-44; Estevez-Abe et al. 2001: 174-176; Vitols 2001: 350-360; Tate 2001: 442-455; Porter 1990: 355-382; 482-507; Hollingsworth 2000:

626-630; Sinn 2005: 18-19; see Freeman 1992; Lindgaard Christensen 1992)[11]. Consequently, the reason for including Italy in the sample is that, of the two remaining EU members covered by the PHID database (France and Italy), firms in Italy can be expected to specialise in the pursuit of an LCP strategy. While collective wage agreements in Italy fix minimum wages which employers must not undercut, these legal wage floors are extremely low compared to the average income in most other European countries. Since minimum wages can, but need not, be topped up by employers, the latter can be expected to exploit the competitive wage advantage for the pursuit of an LCP strategy (see also Porter 1990: 421-453).

So, is it true that British firms specialise in RPI, whereas German companies engage in DQP, while their Italian counterparts prefer the pursuit of an LCP strategy? Tables 1.1 – 1.3. summarise the results obtained from sampling the PHID database[12]. The most important finding for the purpose of this research project is that the resulting firm patterns are virtually the same for Germany, the UK and Italy. In other words, a considerable number of Radical Product Innovators, of Diversified Quality Producers and of Low Cost Producers can be found in Germany, the UK, and Italy alike.

Interestingly, the firm sample is larger for the UK than for Germany and Italy, because comparatively few biotech firms are included in the German sample, while almost no biotech firms are contained in the Italian sample. The reason for this is the difference in age of the British, German, and Italian biotech industries. While the British biotech industry began to cystallize in the 1980s, most German biotech firms were founded in the mid- and late 1990s. Italian biotech firms are even younger, as they were mostly founded around the turn of the millennium[13]. Therefore, many German and most Italian biotech firms had not yet brought a pharmaceutical project beyond the stage of preclinical development, or had done so only shortly before the PHID database was sampled, in November 2004. Since this database considers only those projects which have reached the stage of preclinical development, many German and Italian biotech firms were simply not included at that point in time. Consequently, the German and Italian firm samples are smaller than the British one.

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[11] It should be noted that the competitiveness literature also portrays the US as an ideal-typical economy of flexible market regulation (see e.g. Hall and Soskice 2001b; Hollingsworth 2000; Lindgaard Christensen 1992; Porter 1990: 284-307). However, a comparison of EU and non-EU member states seems unwise. The legal requirements which pharmaceutical firms have to fulfil for obtaining the authorisation to commercialise their products are very demanding. While these requirements are identical for all EU member states, they can differ quite substantially between EU and non-EU countries. Thus, potential differences would not necessarily result from the preferences of pharmaceutical firms to pursue different competitive strategies. They could, simply, result from different legal requirements.

[12] It is important to note that the sample is limited to the last 20 years. In other words, only those firms are considered which are/were involved in at least one pharmaceutical project since 1985.

That said, let us analyse the results reported in tables 1.1.-1.3 in order to classify firms with regard to the competitive strategy they pursue. The most clear-cut distinction between competitive strategies can be made between non-innovative Low Cost Producers on the one hand, and innovation-driven pharmaceutical firms on the other. It should be noted that not one generics company is included in the entire firm sample. As mentioned above, a firm is included in the PHID database as soon as it is, or has been, involved in a pharmaceutical project which has reached the stage of preclinical development. Generics firms, imitating a once patent-protected drug, must not perform any clinical trials as long as they can demonstrate that the imitated drug is bioequivalent to the original pharmaceutical. Avoiding the extremely expensive stages of clinical development is precisely what allows generics firms to produce and market generic drugs at comparatively low prices. Hence, the absence of any generics firm from the sample is rather unsurprising and shows that this category of firms, indeed, pursues an LCP strategy.

A second group of Low Cost Producers consists in those firms which specialise in the registration phase of pharmaceutical products. Apart from these ***Marketing Specialists***, several pharmaceutical firms conclude marketing agreements at the registration stage even though they are also active in R&D. Importantly, though, these seemingly ambiguous cases are almost exclusively constituted by large, internationally-active firms with an extensive product range. In these cases, the in-licensing of pharmaceutical products for commercial purposes does not constitute a strategy in itself, but is rather a means to complete the own product range and to be internationally present. Since these firms do not pursue a genuine LCP strategy, only the pure marketing specialists are counted as Low Cost Producers.

Among the pharmaceutical firms which are active in R&D, the distinction between Radical Product Innovators on the one hand, and Diversified Quality Producers on the other, requires some interpretation. Whilst one group of ***Pure Diversified Quality Producers*** in-licensing pharmaceutical projects at the development stage can be unambiguously identified, the identification of pure Radical Product Innovators is more difficult.

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[13] The question of why the biotech industry is at a different stage of development in Italy, Germany, and the UK will be addressed explicitly and in detail in chapter 5.

Table 1.1.: Radical Product Innovators, Diversified Quality Producers and Low Cost Producers in the UK

Firm Type	Company Name	Technology Focus	Number Employees	Firm Age	Developer NCE	Licensor NCE	Developer Non-NCE	Licensor Non-NCE	Licensee Dev.-Phase NCE	Licensee Dev.-Phase Non-NCE	Licensee Reg.-Phase	Competitive Strategy
Discoverers of NCE	Cancer Research Technology	TrPh	67	41		1		3				RPI
	Celltech Group	BioT	724	24		1		1			1	RPI
	Imperial Cancer Research	TrPh	19	102		1		1				RPI
	Pharmagene	BioT	79	7		1		1				RPI
	Protherics	BioT	219	5		2		1				RPI
Ambiguous Cases	Acambis	BioT	270	12			1*				1	RPI
	Amarin	BioT	24	15				3			1	RPI
	Antisoma	BioT	45	16			1*					RPI
	CeNeS	BioT	14	7			7*				1	RPI
	Henderson Morley	BioT	6	8			1*					RPI
	KS Biomedix	BioT	65	n.a.			1*				2	RPI
	Onyvax	BioT	37	7			1*				1	RPI
	PowderJect	BioT	750	11				2				RPI
	Scotia	BioT	n.a.	20				4				RPI
	SkyePharma	BioT	476	8				4			1	RPI
	Xenova	BioT	105	17				3(*)				RPI
Diversified Quality Producers	Axis Genetics	BioT	n.a.	n.a.			1*			2		DQP
	Britannia	TrPh	130	23			1					DQP
	Galen	TrPh	104	36			1					DQP
	Nycomed Amersham	TrPh	n.a.	130			3	5		3	3	DQP
	Provalis	BioT	107	7			1					DQP
DQPs and RPIs	AstraZeneca	TrPh	11500	91	4	6	16	8	1	12	9	RPI / DQP
	GlaxoSmithKline	TrPh	44679	174	6	20	22	60	3	41	26	RPI / DQP
	Shire	TrPh	475	18		1		9		5	5	RPI / DQP
Pure Diversified Quality Producers	Amersham Pharmacia Biotech	TrPh	4500	n.a.						1		DQP
	Bioglan	BioT	567	72					1	1		DQP
	British Biotech	BioT	250	18						1		DQP
	Cambridge Antibody Technology	BioT	290	14						1		DQP
	Crusade Laboratories	BioT	n.a.	5						1		DQP
	DevCo	TrPh	8	5						1		DQP
	Napp	TrPh	321	81						1		DQP
	Oxford Glyco Sciences	BioT	219	n.a.						1		DQP
	Smith & Nephew	TrPh	1419	73						1		DQP
Marketing Specialists	Allergy Therapeutics	TrPh	180	70							1	LCP
	Biopharm (UK)	BioT	n.a.	n.a.							1	LCP
	Cambridge Laboratories	TrPh	63	17							1	LCP
	Virogen	BioT	n.a.	n.a.							1	LCP

* Project(s) in-licensed at discovery (i.e. research or preclinical development) stage usually from PROs (universities or research institutes)
(*) Part of projects -licensed at discovery (i.e. research or preclinical development) stage usually from PROs (universities or research institutes)

Source: PHID database (November 2004)

Table 1.2: Radical Product Innovators, Diversified Quality Producers and Low Cost Producers in Germany

Firm Type	Company Name	Technology Focus	Number Employees	Firm Age	Developer NCE	Licensor NCE	Developer Non-NCE	Licensor Non-NCE	Licensee Dev.-Phase NCE	Licensee Dev.-Phase Non-NCE	Licensee Reg.-Phase	Competitive Strategy
Discoverers of NCE	BASF	TrPh	37444	139		1		1				RPI
	Merz	TrPh	800	96		1		4				RPI
Ambiguous Cases	Curacyte	BioT	22	5			1*					RPI
	Degussa	TrPh	6000	5			1*					DQP
	Falk	TrPh	99	44			1*					DQP
	GPC Biotech	BioT	115	7			1*					RPI
	Jerini Bio Tools	BioT	108	10			1*					RPI
	MediGene	BioT	120	10			1*					RPI
	MorphoSys	BioT	132	12			1*					RPI
	Scil Biomedicals	BioT	100	5			1*				1	RPI
	Wilex Biotechnology	BioT	22	7			1*					RPI
Diversified Quality Producers	Altana	TrPh	2800	27				9		1	5	DQP
	Gruenenthal	TrPh	1900	58			2				5	DQP
	Jenapharm	TrPh	450	54			2					DQP
	Madaus	TrPh	930	85				5	1	2		DQP
	Merck KGaA	TrPh	1800	336			2	6		4		DQP
	Merckle	TrPh	2000	59			2				1	DQP
	Schwarz Pharma	TrPh	1200	58			2		1	2	7	DQP
DQPs and RPIs	ASTA Medica	TrPh	600	169		1		1	1	1	3	RPI / DQP
	Bayer	TrPh	5181	141	1	3	1	18	1	8	5	RPI / DQP
	Boehringer Ingelheim	TrPh	8000	119		7	1	26		5	11	RPI / DQP
	Schering AG	TrPh	10042	133	2	2	15	6		8	4	RPI / DQP
Pure Diversified Quality Producers	GLE Medicon	TrPh	n.a.	n.a.						1		DQP
	Medac	BioT	400	34						2		DQP
	Paion	BioT	60	4						1		DQP
	Revotar	BioT	22	4						1		DQP
Marketing Specialists	Plantorgan	TrPh	100	30							1	LCP
	Schwabe	TrPh	695	138							1	LCP
	Strathmann	TrPh	460	30							1	LCP

* Project(s) in-licensed at discovery (i.e. research or preclinical development) stage usually from PROs (universities or research institutes)
(*) Part of projects -licensed at discovery (i.e. research or preclinical development) stage usually from PROs (universities or research institutes)

Source: PHID database (November 2004)

Table 1.3.: Radical Product Innovators, Diversified Quality Producers and Low Cost Producers in Italy

Firm Type	Company Name	Technology Focus	Number Employees	Firm Age	Developer NCE	Licensor NCE	Developer Non-NCE	Licensor Non-NCE	Licensee Dev.-Phase NCE	Licensee Dev.-Phase Non-NCE	Licensee Reg.-Phase	Competitive Strategy
Discoverers of NCE	Abiogen	BioT	257	7	1	1		7				RPI
	Alfa Wassermann	TrPh	700	56		1		4			3	RPI
	Ausonia	n.a.	n.a.	n.a.		1		3				RPI
	Istituto di Ricerche Sigma Tau	TrPh	67	19		2		5			5	RPI
	Medioloanum	TrPh	253	32		1	1*	4			1	RPI
	Poli	TrPh	126	25	1		3(*)					RPI
	SPA	TrPh	211	57		1		1				RPI
Ambiguous Cases	Fidia	TrPh	n.a.	58			1*					DQP
	Italpharmaco	TrPh	600	66			1*				1	DQP
	Rotta Research	BioT	188	43				1				RPI
Diversified Quality Producers	Chiesi	TrPh	2600	69			2	7	2	2		DQP
	Recordati	TrPh	1013	78				8	1	1	4	DQP
	Zambon	TrPh	836	98			3		1	2	1	DQP
DQPs and RPIs	Bracco	TrPh	1456	77	1	1	1	3		1	1	RPI / DQP
	Menarini	TrPh	2050	118	1		4		1	1	5	RPI / DQP
Pure Diversified Quality Producers	Bruno	TrPh	n.a.	n.a.					1	1		DQP
	Dompe	TrPh	600	64						1	2	DQP
	Eurand	TrPh	343	35						1		DQP
	Geymonat	TrPh	83	76					1	1		DQP
Marketing Specialists	Biotoscana	BioT	n.a.	n.a.							1	LCP
	Formenti	TrPh	450	50							1	LCP
	Guidotti	TrPh	480	90							2	LCP
	Lusopharmaco	TrPh	600	53							2	LCP
	Mipharm	TrPh	243	6							1	LCP
	Neopharmed	TrPh	332	n.a.							1	LCP
	Rottapharm	TrPh	371	43							1	LCP
	Segix	TrPh	74	42							1	LCP

* Project(s) in-licensed at discovery (i.e. research or preclinical development) stage usually from PROs (universities or research institutes)
(*) Part of projects -licensed at discovery (i.e. research or preclinical development) stage usually from PROs (universities or research institutes)

Source: PHID database (November 2004)

Interestingly, no single firm exists which merely develops or out-licenses pharmaceutical products based on an NCE. As shown by Utterback (1994), a new dominant design occurs much less frequently than the improvement of an already existing dominant design. This finding also holds for the pharmaceutical industry. Here, the discovery of an NCE is by far less frequent than the improvement of a known chemical entity. As in any research project, the chance element involved in pharmaceutical research is high, making the actual outcome rather unpredictable (Muffatto and Giardina 2003: 111). Hence a pharmaceutical firm *cannot be sure* that it will discover an NCE. It can make all possible efforts, yet it may ultimately end up using its research outcomes for improving an already known chemical entity. That said, a pharmaceutical firm *can decide to focus* on the research stage (i.e. on the discovery and preclinical development) of pharmaceutical projects in that it out-licenses their development and registration to (an)other firm(s). Accordingly, licensors of both NCE and non-NCE projects can be said to be more innovative than licensees focusing on the development or registration of a pharmaceutical project. I therefore classified all pharmaceutical firms which had (developed and/or) out-licensed *at least 1* pharmaceutical project *based on an NCE* as Radical Product Innovators because they are ***discoverers of NCEs*** with a strong propensity to out-license the clinical development and registration of pharmaceutical projects to other firms.

This leaves us with a group of ***ambiguous cases*** composed of firms which are *either* pure licensors of already discovered chemical entities, *or* they are developers of known chemical entities which were in-licensed at the research stage from Public Research Organisations (henceforth PROs), i.e. universities or research institutes. On the one hand, these firms are not particularly innovative as the resulting pharmaceutical products are based on known chemical entities. On the other hand, they are innovative as the *licensors* focus on the research stage of a pharmaceutical project. Similarly, the *developers* of this group have a research focus, as they collaborate closely with PROs, from which they in-licensed pharmaceutical projects at the research stage. Often, these projects have not yet arrived at the stage of clinical development or registration – meaning that the respective developers (still) have a strong research focus. Since the classification of these firms is not possible purely on the basis of their involvement in the different stages of pharmaceutical projects, I have categorized them on the basis of their technological approach. Accordingly, I classified all pharmaceutical firms relying on the more modern biotechnology as Radical Product Innovators, whereas I categorised all pharmaceutical firms relying on more traditional technologies as Diversified Quality Producers.

Another, partly similar group of firms can be identified. These firms are similar to the group of ambiguous cases in that they are either developers and/or licensors of already discovered

chemical entities. However, in contrast to the previous group of firms, they do *not* in-license pharmaceutical projects at the *research stage*. Instead, they in-license projects at the *development stage* which, in turn, suggests that they are rather incrementally than radically innovative. Accordingly, I have classified them as ***Diversified Quality Producers***. In addition, all those firms which are exclusive developers of pharmaceutical products based on known chemical entities have also been classified as Diversifed Quality Producers.

Finally, a last group of cases consists of those pharmaceutical firms which pursue both an ***RPI and a DQP*** strategy. On the one hand, they are Radical Product Innovators, as they out-license (and develop) pharmaceutical products based on NCEs. On the other hand, these firms also pursue a DQP strategy by developing drugs based on previously discovered chemical entities, or by in-licensing pharmaceutical projects at the development stage. I therefore classified these firms as Radical Product Innovators and Diversified Quality Producers alike.

The existence of this last group of firms raises one important question which I want to address before proceeding to a final evaluation of cases: Are the three competitive strategies mutually exclusive or can a firm pursue two, or even three strategies at the same time?

1.3.3. The Mutual Exclusivity of Competitive Strategies

The question of whether the three competitive strategies are mutually exclusive brings us back to the Abernathy-Utterback model (Utterback 1994: 90-101). Utterback's in-depth studies of various industries show that firms initiate a product's life cycle by proposing radically new product designs. Once a dominant design has emerged, firms usually start to change their competitive strategy in that they turn from radical innovators into incremental innovators or imitators. In other words, as time goes by, firms which once pursued an RPI strategy turn either into Diversified Quality Producers making slight improvements to a once radically new product or into Low Cost Producers manufacturing and selling at the lowest possible price. This said, it is important to note that Porter shows DQP and LCP to be mutually exclusive strategies because 'differentiation [i.e. DQP] is usually costly' (Porter 1985: 119-120) and therefore not compatible with LCP. The reason is that 'a firm must often incur costs to be unique because uniqueness requires that it performs value activities better than competitors. Providing superior applications engineering support usually requires additional engineers, for example, while a highly skilled sales force typically costs more than a less skilled one. Achieving greater product durability than competitors may well require more material content or more expensive materials (...)' (Porter 1985: 127-128).

Interestingly, Utterback also shows that the strongest resistance to the introduction of a radically new technology often comes from the industry's Diversified Quality and Low Cost Producers which were radically innovative at the last innovation wave. According to Utterback, the reason for this is that over time these firms have accumulated significant sunk costs to enable the production of highly sophisticated or particularly cheap goods. Inventing and producing an entirely new product means competing against their own, existing goods, and to risk that the latter will sooner or later become obsolete. This, in turn, means to cannibalise on the returns resulting from the production and sale of the existing goods (Utterback 1994: 162-165; 223-226). Thus, particularly in traditional industries, RPI, DQP and LCP are mutually exclusive in that a firm is most likely to maximise its returns on investment if it pursues just one competitive strategy.

This argument also seems to apply to the pharmaceutical industry: The fact that the firm sample contains one clear-cut group of Low Cost Producers (***Marketing Experts***), ***(pure) Diversified Quality Producers*** and Radical Product Innovators (***NCE-Discoverers*** *being often pure Licensors*) confirms the idea that LCP, DQP and RPI are mutually exclusive strategies. But how do we explain the fact that the sample also contains one group of ***ambiguous cases***, and one group of cases which pursue both an ***RPI and a DQP*** strategy?

In contrast to traditional industries, the pharmaceutical industry is peculiar in two respects. Firstly, like all high-tech industries, the technology intensity of pharmaceutical R&D allows for a comparatively frequent emergence of new dominant designs. Yet, in contrast to traditional industries, the emergence of a new dominant design, i.e. of an NCE, does not entail a wholesale transformation of the industry. Its effect is rather to improve the market position of a firm. The technology intensity of the pharmaceutical industry therefore makes RPI a particularly attractive strategy as the risk of making the firm's own products obsolete is comparatively low.

Secondly, the pharmaceutical industry is also peculiar in that the development of a new product is extremely expensive (see e.g. Muffatto and Giardina 2003: 108-110). In order to obtain a marketing authorisation, a pharmaceutical firm must carry out a large variety of clinical tests in order to document all the features and possible (side-)effects of the product. This means that any Radical Product Innovator which does not want to concentrate merely on pharmaceutical discovery by out-licensing pharmaceutical development and registration, but which also aspires to turn its discoveries into marketable drugs, will find it necessary to start pursuing a DQP strategy at a certain point. The reason is that the firm can thereby cover the massive costs linked to clinical development. The longer a patent shelters a pharmaceutical product from low cost imitations, the higher the product's returns on investment. Therefore, once a patent expires,

pharmaceutical firms often seek to obtain a new patent, or to extend patent protection, by introducing slight improvements to the once radically new drug. Furthermore, a pharmaceutical firm is well-advised to in-license pharmaceutical projects in its field of expertise in order to use its development (and registration) facilities efficiently. Thus, any research-intensive firm which wants to develop and register its pharmaceutical discoveries on its own will find it necessary to cover costs by pursuing a DQP strategy in parallel to an RPI strategy.

Following this logic, it can be argued that the group of *ambiguous cases* consists mostly of those firms that have reached the point where they must decide whether to pursue a *pure RPI strategy* out-licensing clinical development and registration, *an RPI and a DQP strategy*, or whether to use their expertise for becoming *(pure) Diversified Quality Producers*. If this life-cycle argument holds true, we should find that the *discoverers of NCEs*, the *DQP/RPI firms*, and the *(pure) Diversified Quality Producers* are older than those firms classified as *ambiguous cases*. With a view to assessing this idea, I assigned an ambiguity score of 0 to all NCE-discoveres, DQP/RPI-firms, and (pure) Diversified Quality Producers, whereas I attributed an ambiguity score of 1 to all the ambiguous cases. The result of a bivariate correlation analysis shows that a strong correlation actually exists between a firm's age and the pursuit of an unambiguous competitive strategy ($R = -.405$; $R^2 = .164$; $p < 0.001$).

Turning back to those firms which pursue both an RPI and a DQP strategy simultaneously, it is interesting to note that these firms usually embed each strategy in a separate business unit. From an operational point of view, these business units are independent in that they encompass all those departments necessary for discovering, developing and producing drugs. Accordingly, the two business units are only interdependent in that they are financed by the same holding company. In a strict sense, *one* RPI/DQP firm does not therefore pursue *two* different competitive strategies. Instead, *two* different business units belonging to one holding company pursue *one* competitive strategy apiece. Accordingly, it is unsurprising that the group of pharmaceutical firms pursuing both an RPI and a DQP strategy consist almost exclusively of the industry's international giants. These findings confirm that Radical Product Innovation and Diversified Quality Production are incompatible from an operational point of view because each strategy requires a separate business unit.

In sum, the argument that these three competitive strategies are mutually exclusive, as they all follow a different operational logic, is justifiable both from a theoretical and an empirical perspective. This is particularly true for LCP on the one hand, and the cost-intensive DQP and RPI on the other. Nevertheless, due to their different technological foci, DQP and RPI are also mutually exclusive. Accordingly, the firm sample indicates that a company cannot pursue the

latter strategies at the same time, unless they are embedded in two separate business units.[14] In sum, while the identification of a firm's competitive strategy is definitely not without its problems, the classification approach used in this section clearly illustrate one point: Contrary to the expectations of the competitiveness literature, patterns in the strategies of pharmaceutical firms are strikingly homogenous in Italy, Germany and the UK alike.

1.3.4. Final Assessment

Let us finally assess whether firms in different political economies vary in the extent to which they pursue different competitive strategies. Is the competitiveness literature right in suggesting that firms in the UK specialise in the pursuit of an RPI strategy, whereas German companies rather pursue a DQP strategy, whilst their Italian counterparts engage mostly in LCP (Hall and Soskice 2001a: 38-44; Estevez-Abe et al. 2001: 174-176; Vitols 2001: 350-360; Tate 2001: 442-455; Porter 1990: 482-507; 355-382; 421-453; Hollingsworth 2000: 626-630; Sinn 2005: 18-19; see Freeman 1992; Lindgaard Christensen 1992)?

Table 1.4. summarises the results obtained from sampling the PHID database[15]. These summary results do not provide empirical support for the idea that the vast majority of firms in the same political economy pursue the same competitive strategy. Instead, table 1.4. shows that firms in Germany, Italy, and the UK alike pursue all three types of strategy. While 47.5% of pharmaceutical firms pursue an RPI strategy in the UK, 39.4% of firms pursue this strategy in Germany, and 34.5% of their counterparts do so in Italy. The DQP strategy, in turn, is pursued by 51.5% of German, by 37.9% of Italian, and by 42.5% of British firms. Finally, the probability that firms purse an LCP strategy is 27.6% in Italy, 10.0% in the UK and 9.1% in Germany. Thus, even though the number of firms pursuing the same strategy varies from one economy to another, it is not drastically different between the considered countries.

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[14] While I will carry out in-depth analyses in chapters 2 to 4, it is worthwhile to mention here that empirical evidence confirms the operational incompatibility of RPI, DQP and LCP, because each strategy requires a very specific and distinct set of input factors.

[15] The nine firms which pursue both an RPI and a DQP strategy are counted as two cases each.

Table 1.4.: Summary Results of RPI, DQP and LCP in the UK, Germany and Italy

	Radical Product Innovators		Diversified Quality Producers		Low Cost Producers		Sum	
	Nb Firms	*% Firms*	Nb Firms	*% Firms*	Nb Firms	*% Firms*	Nb Firms	*% Firms*
UK	19	*47.5%*	17	*42.5%*	4	*10.0%*	40	*100.0%*
Germany	13	*39.4%*	17	*51.5%*	3	*9.1%*	33	*100.0%*
Italy	10	*34.5%*	11	*37.9%*	8	*27.6%*	29	*100.0%*
Average	14.0	*40.5%*	15.3	*44.0%*	5.0	*15.6%*	34.0	
Above Average		*7.0%*		*7.5%*		*12.0%*		

Source: PHID database

While table 1.4. shows that firms in the same economy are far from pursuing *the same* strategy, slight specialisation patterns can be observed. Table 1.4. reports the average probability that companies in Germany, Italy and the UK will pursue an RPI, a DQP or an LCP strategy. Interestingly, British firms are 7.0% more likely to engage in Radical Product Innovation than the average pharmaceutical firm included in the sample. Similarly, the probability of pursuing a DQP strategy is 7.5% higher for a German firm than for the sample's average company. Finally, Italian firms show a preference for Low Cost Production as they pursue this strategy 12.0% more often than the average pharmaceutical company. In other words, British firms seem to prefer Radical Product Innovation, whereas German firms show a preference for Diversified Quality Production. Italian firms, in turn, choose to pursue an LCP strategy. Thus, even though the *majority* of companies in the same economy definitely do not pursue the same competitive strategy, the competitiveness literature could be right to the extent that firms *specialise* in the pursuit of the same strategy (see Hall and Soskice 2001a: 38-44; Estevez-Abe et al. 2001: 174-176; Vitols 2001: 350-360; Tate 2001: 442-455; Porter 1990: 482-507; 355-382; 421-453; Hollingsworth 2000: 626-630; Sinn 2005: 18-19; see Freeman 1992; Lindgaard Christensen 1992).

Since the observed strategy-specialisation patterns are not pronounced, the question arises as to whether they are statistically significant enough to support the latter interpretation of the competitiveness literature. To answer this question, I carried out a Chi-Square test which assesses the strength of the association between a firm's *location* and the probability that the firm pursue a specific *strategy*. Results are reported in table 1.5. At a glance, the table shows that differences in strategy-specialisation patterns are too weak to produce significant results. This tells us that the specialisation patterns observed in table 1.4. are the result of an (un)fortunate coincidence rather

than of explicit firm preferences for the pursuit of different strategies. Thus, no empirical evidence can be found for the central argument of the competitiveness literature that firms in the same political economy pursue, or specialise in, the pursuit of the same competitive strategy.[16]

Table 1.5.: Results of Cross Tabs Test (Country x Competitive Strategy) [a]

			Competitive Strategy			Total
			RPI	DQP	LCP	
Country	UK	*Count*	*19*	*17*	*4*	*40*
		Expected Count	16.5	17.6	5.9	40.0
	Germany	*Count*	*13*	*17*	*3*	*33*
		Expected Count	13.6	14.6	4.9	33.0
	Italy	*Count*	*10*	*11*	*8*	*29*
		Expected Count	11.9	12.8	4.3	29.0
Total		*Count*	*42*	*45*	*15*	*102*
		Expected Count	42.0	45.0	15.0	102.0

[a] Chi-Square = 5.996 (2 cells = 22.2 % with expected count less than 5); $p > 0.10$; Cramer's V = .171; $p > .10$

1.4. Research Aim, Assumptions and Hypotheses

To recapitulate the above, the strategy-specialisation argument of the competitiveness literature rests on two assertions. Firstly, the pursuit of one specific strategy is said to require one specific set of input factors (Hall and Soskice 2001a: 21-44).(Estevez-Abe et al. 2001: 174-175; Vitols 2001: 350-352; Tate 2001: 445-446; 468; Freeman 1992: 170-171; 182; Ohlin 1933: 7; 51-55; see Porter 1985: 127-128; Lundvall 1992c: 57-58; Lindgaard Christensen 1992: 153; 160-163; Sinn 2005: 18-19) Secondly, national institutions are held to provide just one set of input factors (Hall and Soskice 2001a: 21-33; Estevez-Abe et al. 2001: 145-155; Vitols 2001; Tate 2001; Hollingsworth 2000: 626-630; Lindgaard Christensen 1992: 153; 160-163; see Freeman 1992: 170-171; 182; Porter 1990: 69-130; Sinn 2005; Heckscher 1919: 55-58; Ohlin 1933: 6). While both assertions are plausible in themselves, jointly they lead to the central argument of the literature that a majority of firms in the same political economy will pursue the same competitive strategy (see Heckscher 1919; Ohlin 1933; Sinn 2005; Porter 1990; Freeman 1992; Lindgaard Christensen 1992; Nelson 1993; Hollingsworth 2000: 626-630; see in particular Hall and Soskice

[16] It should be noted that the present analyses do not consider firm performance. That is, I do not consider whether firms perform better or worse according to the institutional environment within which they choose to pursue a

2001a: 38-44; Estevez-Abe et al. 2001: 174-176; Vitols 2001: 350-360; Tate 2001: 442-455). The above analyses have shown this claim to be wrong: Firms in the same economy do not specialise in the same competitive strategy. Hence, the question arises of how this finding can be reconciled with the central argument of the competitiveness literature?

It is the aim of my research to shed light on this puzzle in general, and to reveal the sources of international firm competitiveness in particular. More precisely, I ask how firms in the same economy can pursue different competitive strategies, despite unilaterally facilitative institutions[17]. In other words, how is it possible that firms in the same institutional environment compete by pursuing different strategies? To answer this question, the following chapters will test the two sets of hypotheses upon which the central argument of the competitiveness literature is grounded. Accordingly, my analyses will proceed in two steps: To begin with, I will test the hypothesis that each competitive strategy requires a specific set of input factors. Having identified those factors that are indispensable for the pursuit of each strategy, I will assess in the second step whether specific national institutions are the only providers of these factors.

Potentially, a large number of input factors exist which may facilitate the pursuit of a particular competitive strategy (see e.g. Porter 1985: 85-86; 122; 343-350). To limit the scope of my research endeavour, I focus on those factors which are decisive for the success of each strategy. To this end, the competitiveness literature is very instructive. Pointing out that three input factors – namely (1) *financial means*, (2) *labour qualifications*, and (3) new *component standards* – cannot be secured by a firm acting alone, the literature assumes these three factors to be decisive for the success of any company (see in particular Hall and Soskice 2001a: 6-7; see also Lundvall 1992a: 13-15; Andersen 1992: 68-69; Patel and Pavitt 1994: 91-92; Hollingsworth 2000: 627-628; 632; Porter 1990: 20). The reason for this is that the respective factors are only provided following the successful solution of a coordination problem between a firm and other economic actors (Hall and Soskice 2001a: 6). Accordingly, the provision of *finance* depends on he successful solution of the *principle-agent problem* between a firm and its financiers (Mayer 998: 145-146; Vitols 2001: 337; Kenyon and Vitols 2004: 11), whilst *adequately skilled mployees* can only be secured if the *free-riding problem* related to the training of employees is esolved (Le Gales and Voelzkow 2001: 4-5; Hall and Soskice 2001a: 25-26; see Estevez-Abe et l. 2001: 145; Culpepper 2001: 278-281). Similarly, new *component standards* can only be greed if the *hold-up problem* between competing firms is overcome (see Tate 2001: 442-443;

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ecific competitive strategy. The reason for this is that I dedicate a separate chapter to the discussion of how ational institutions impact on the performance of a firm's competitive strategy (see chapter 5).

In line with Steeck and Thelen (2005: 9-16), I understand institutions as 'formalized rules that may be enforced by alling upon a third party' (Streeck and Thelen 2005: 10).

Hall and Soskice 2001a: 26-27; 30-31; Rogerson 1992: 777; Malcomson 1997: 1916-1917). While a more in-depth discussion of these coordination problems will be provided in the following chapters, suffice it to say here that I will limit my analyses to the impact, and the institutional provision of finance, labour qualifications, and new component standards.

As pointed out in the beginning of this section, the reasons why the competitiveness literature may be wrong in suggesting that firms in the same economy specialise in the same competitive strategy are essentially twofold. It could, firstly, be possible that the literature wrongly assumes each competitive strategy to require a specific set of input factors. Should this be the case, it would simply not matter which factors were provided by national institutions. Secondly, a specific strategy may indeed require specific input factors, yet the latter could be provided by many different institutions. In other words, the competitiveness literature may ignore that specific factors can be provided by a variety of functionally equivalent institutions. In both scenarios, the extent to which national institutions provide specific input factors would be irrelevant.

In aiming at understanding how firms in the same institutional environment can pursue different competitive strategies, I will assess these two sets of hypotheses, as proposed in the competitiveness literature. Accordingly, the first question is:

1. Is it true that the pursuit of an RPI, a DQP, and an LCP strategy requires specific types of finance, labour qualifications, and component standards (see Hall and Soskice 2001a: 21-44; Estevez-Abe et al. 2001: 174-175; Vitols 2001: 350-352; Tate 2001: 445-446; 468; Hollingsworth 2000: 626-630; Freeman 1992: 170-171; 182; Ohlin 1933: 7; 51-55; Porter 1985: 127-128; Lundvall 1992c: 57-58; Lindgaard Christensen 1992: 153; 160-163; Sinn 2005: 18-19)? Should this hypothesis be verified, I will secondly enquire:
2. Is it true that those input factors, required for the pursuit of a given strategy, are only provided by specific national institutions (see Hall and Soskice 2001a: 21-33; Estevez-Abe et al. 2001: 145-155; Vitols 2001; Tate 2001; Hollingsworth 2000: 626-630; Lindgaard Christensen 1992: 153; 160-163; Freeman 1992: 170-171; 182; Porter 1990: 69-130; Sinn 2005; Heckscher 1919: 55-58; Ohlin 1933: 6)?

In the following chapters, I seek to answer these questions for each of the three input factors separately.

1.5. Concluding Remarks and Outlook

This chapter has clearly illustrated one point: as soon as a firm's competitive strategy is identified at the *firm* rather than at the *industry level*, no national strategy-specialisation patterns can be observed[18]. This finding is puzzling as it contradicts the central argument of the competitiveness literature, i.e. that firms in the same economy exploit national institutional advantages by specialising in the same competitive strategy (see Heckscher 1919; Ohlin 1933; Sinn 2005; Porter 1990; Freeman 1992; Lindgaard Christensen 1992; Nelson 1993; Hollingsworth 2000: 626-630; see in particular Hall and Soskice 2001a: 38-44; Estevez-Abe et al. 2001: 174-176; Vitols 2001: 350-360; Tate 2001: 442-455). It is the aim of my research to shed light on this puzzle by studying the link between national institutions, input factors, and competitive strategies. Accordingly, I ask how firms in the same institutional environment can compete internationally by pursuing different strategies. To this end, I will first isolate those financial means, labour qualifications, and component standards which are indispensable for the pursuit of an RPI, a DQP, and an LCP strategy. Once identified, I will assess which institutions provide the respective input factors.

Since I will study the link between the institutional provision of input factors and their impact on competitive strategies for each input factor separately, the remaining parts of this thesis are organised as follows. Chapter 2 analyses the importance of diverse ***financial means*** for the pursuit of an RPI, a DQP, and an LCP strategy. In so doing, I find the competitiveness literature right in suggesting that each strategy relies on specific types of finance – although the literature is wrong with regard to the *exact* financial means that actually promote each strategy (see Vitols 2001; Bronk 1998; Mayer 1998; CPB Netherlands 1997; Lindgaard Christensen 1992: 146-147; 162; see also Hall and Soskice 2001a: 27; 39-41; Hollingsworth 2000: 628; Ohlin 1933: 7; 55). Empirical evidence shows that Radical Product Innovation is facilitated by institutional share capital and long-term debt, while Diversified Quality Production relies on private share capital. Low Cost Producers, in turn, mostly finance their activities from short-term liabilities. Consequently, the only strategy on which national institutions can have a facilitative impact is Radical Product Innovation, in that national pension and insurance systems differ in the extent to which they stimulate the emergence of institutional investors. I therefore investigate in a second

[18] It is noteworthy that strategy-specialisation patterns can only be observed if the technology intensity of a firm's *industry* is used as a proxy for competitive strategy, because this indicates that the competitiveness literature misinterprets empirical evidence. That is, differences in the development of national (high-tech) industries seem to be historically grounded, rather than the result of country-specific firm preferences for a given strategy. Since this argument will be explored in-depth in chapters 5 and 6, suffice it to say here that an historical explanation of industry development seems more plausible than the functionalist approach of the competitiveness literature.

step how radically innovative firms acquire institutional share capital in countries where this type of finance is scarce. In so doing, I find that many firms in these economies simply turn to international financial markets in order to secure institutional share finance from abroad.

Chapter 3 analyses how different ways of elaborating new ***component standards*** impacts on an RPI, DQP, and LCP strategy. To begin with, a strong correlation is found to exist between a firm's competitive strategy and its standardisation policy. However, contrary to the findings on finance, empirical evidence shows that a firm's standardisation policy *does not facilitate* a specific strategy. Instead, it is a *result of* the latter. In other words, specific component standards do not constitute a necessary input factor for the pursuit of a given strategy, but emerge from it. This finding makes any further analysis of how institutions provide component standards superfluous. Nevertheless, I briefly review how firms collaborate in order to develop new component standards in accordance with the competitive strategy they pursue. In so doing, I arrive at a similar finding as that of chapter 2: The competitiveness literature in general (Heckscher 1919; Ohlin 1933; Sinn 2005; Lundvall 1992b; Nelson 1993; Porter 1990), and the literature on 'varieties of capitalism' in particular (Hall and Soskice 2001b), overestimate the stringency of national institutions on the one hand, and underestimate the international dimension of economic activity on the other.

In chapter 4, I assess the importance of specific ***labour qualifications*** (namely *skill levels* and *skill profiles)* for the pursuit of different competitive strategies. While the hypothesis that low *skill levels* constitute a necessary input factor for Low Cost Production is shown to lack empirical support (see Ohlin 1933: 7; 51-54; Sinn 2005: 18-19; Porter 1985: 127-128; Hall and Soskice 2001a: 44; Estevez-Abe et al. 2001: 175), I find that employees with certain *skill profiles* are actually indispensable for the pursuit of an RPI and a DQP strategy (Estevez-Abe et al. 2001: 174; Hall and Soskice 2001a: 39-41; see Porter 1985: 127-128; Freeman 1992: 170-171; 182; Hollingsworth 2000: 626-630; Ohlin 1933: 51). More precisely, employees with firm-specific skills are central to Diversified Quality Production, whereas employees with field-specific skills are essential for Radical Product Innovation. Following up on this finding, chapter 4 continues with an analysis of how national institutions, namely differences in labour-market regulation, impact on the provision of the required skill profiles. How do firms in flexible labour markets secure a workforce with firm-specific skills, and how do firms in rigid labour markets attract employees with field-specific skills? Addressing these questions, I illustrate that a variety of ways exist by which employers circumvent national labour-market regulation – be it by turning to international labour markets, by (mis)using training subsidies provided by the government, or by developing particularly strong links to local, national, and international universities.

Before concluding, chapter 5 opens up an excursus on strategy choice and change over time. Since all previous analyses are of a static nature, chapter 5 attempts to provide some dynamic insights. While synchronic empirical evidence shows that firms in the same economy can pursue different competitive strategies, I acknowledge that from a diachronic perspective one last possibility exists in which the competitiveness literature could be right with regard to its strategy-specialisation argument (see Hall and Soskice 2001a: 38-44; Estevez-Abe et al. 2001: 174-176; Vitols 2001: 350-360; Tate 2001: 442-455; Porter 1990: 482-507; 355-382; 421-453; Hollingsworth 2000: 626-630; Sinn 2005: 18-19; see Freeman 1992; Lindgaard Christensen 1992). It could be possible that firms which choose to pursue a strategy that is *not* facilitated by national institutions are destined to fail in the long run. I therefore analyse whether the stability of a competitive strategy depends on the institutional context in which it is pursued. Since empirical evidence refutes this idea, I propose an alternative explanation for strategy stability on the one hand, and strategy choice on the other. Regarding strategy stability, it seems that firms are more likely to change their legal status in general, and their strategy in particular, if they are situated in countries where seed finance for new businesses can be acquired comparatively easily. Regarding a firm's strategy choice, I find the latter to depend on the extent to which entrepreneurs attempt to seize technological opportunities in order to develop them into marketable products. While it is beyond the scope of my research project to understand which conditions make entrepreneurs seize technological opportunities, my analyses clearly demonstrate that national institutions do not constitute a significant determinant, if any at all, of an entrepreneur's strategy choice.

Finally, chapter 6 concludes with a summary interpretation of the results obtained. In recapitulating that diverse institutional pathways to international firm competitiveness exist, I find that the competitiveness literature falls short in one essential point, namely in its overly narrow focus on *national* institutions (see Lundvall 1992b; Nelson 1993; Porter 1990; Hall and Soskice 2001b; see also Ohlin 1933: 52-53; Sinn 2005: 68). This makes the literature ignore that required input factors are not only provided by national institutions. As a matter of fact, entrepreneurs often circumvent national institutions in order to secure required factors through what I call *'improvisation' on a contractual basis*, and through *'importation' by drawing on international institutions*. This finding has two noteworthy implications. Firstly, given the variety of institutional equilibria on which firms' competitiveness are grounded, institutions most definitely do not assume a shape with the aim of supporting one specific production regime. Hence, I retain a historical account to be more useful for explaining institutional development than the functionalist approach proposed in the competitiveness literature. Secondly, the inventiveness with which entrepreneurs secure required input factors indicates that entrepreneurs

are Schumpeterian innovators rather than institutionally constrained actors. Accordingly, Schumpeter's perception of entrepreneurs as independent innovators (see e.g. Schumpeter 1934, chapter 4; Schumpeter 1942: 81-106) is more instructive for understanding how firms gain international competitiveness than the approach of the competitiveness literature, which perceives entrepreneurs as mere institution-takers. These insights lead me to conclude that the increasing internationalisation of economic affairs leads to *divergence in the shape of institutions*, whilst simultaneously entailing *convergence in entrepreneurial practices*.

2. On the Link between Institutions, the Provision of Specific Financial Means, and Their Impact on Competitive Strategies *

2.1. Entrepreneurs: Constrained Institution-Takers or Voluntaristic Innovators?

No firm can operate without financing its activities. The idea that finance constitutes an indispensable input factor for the pursuit of any competitive strategy is an uncontested fact. However, a broad strand of the competitiveness literature devotes itself to the question of whether specific *types of finance* facilitate specific strategies (Vitols 2001; Bronk 1998; Mayer 1998; CPB Netherlands 1997; Lindgaard Christensen 1992; see also Hall and Soskice 2001a: 39-41; Hollingsworth 2000: 628; Ohlin 1933: 7; 55). Finding this to be the case, the literature also asserts that national corporate-governance systems differ with regard to the types of finance they provide. In so-called *outsider systems*, the participation rights of shareholders are limited, so that the latter are said to provide *outsider share capital*[19]. In *insider systems*, by contrast, shareholders have an important say in major corporate decisions, and are thus held to supply *insider share capital*[20] (see Bronk 1998: 5; CPB Netherlands 1997: 348-351; 357-362; Mayer 1998: 146-149). Overall, these findings lead to the central argument of the competitiveness literature that firms in the same corporate-governance system are provided with the same type of finance which, in turn, makes them specialise in the same competitive strategy (Hall and Soskice 2001a: 39-40; Vitols 2001: 350-352; Bronk 1998: 15; CPB Netherlands 1997: 355-356; Mayer 1998: 159-160; 162; Ohlin 1933: 7; 55; Lindgaard Christensen 1992: 146-147; 162; Hollingsworth 2000: 628).

Chapter 1 has demonstrated that this claim of the competitiveness literature is wrong: firms in the same economy pursue different competitive strategies to the same extent. Hence, the introductory chapter leaves us with an interesting puzzle to be explained. How can firms in

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[19] It should be noted that the literature uses various terms to describe the same type of corporate-governance system, and the type of finance it provides. More precisely, the *outsider system* (Mayer 1998)– associated with limited shareholder rights and greater firm flexibility – is also called *shareholder model* (Vitols 2001; Bronk 1998). Accordingly, the type of finance provided is not only termed *outsider*, but also *short-term*, or *impatient share capital* (idem; see also Hall and Soskice 2001a: 22).

[20] As with outsider systems, the literature also uses various different terms for insider corporate-governance systems and the type of finance it provides. More precisely, the *insider system* (Mayer 1998) – associated with important shareholder rights and lower firm flexibility – is also called the *stakeholder model*, whereas the type of finance provided is not only termed *insider*, but also *long-term*, or *patient share capital* (Vitols 2001; Bronk 1998; see also Hall and Soskice 2001a: 22).

different countries pursue the same *variety* of competitive strategies, even though national corporate-governance systems are said to facilitate the pursuit of just *one* strategy? My research aims at answering this question by studying the link between (national) institutions[21], input factors, and competitive strategies. In so doing, the present chapter focuses on the relationship between *corporate-governance systems*, the provision of the input factor *finance*[22], and the *three competitive strategies* Radical Product Innovation (henceforth RPI), Diversified Quality Production (henceforth DQP), and Low Cost Production (henceforth LCP)[23]. To this end, I aim to assess the two sets of hypotheses proposed in the competitiveness literature. Accordingly, I ask:

1. whether it is true that an RPI, a DQP, and respectively an LCP strategy requires specific types of finance (Vitols 2001: 350; 359-360; Hall and Soskice 2001a: 27; 39-41; CPB Netherlands 1997: 354-356; Bronk 1998: 14-15; see Lindgaard Christensen 1992: 162; Ohlin 1933: 7; 55)? Once all the necessary types of finance have been identified, I continue by asking:
2. whether it is true that each type of finance is only provided by country-specific corporate-governance regulations (Vitols 2001: 350-352; Hall and Soskice 2001a: 27; 27-29; CPB Netherlands 1997: 351-354; Bronk 1998: 5-8; see Lindgaard Christensen 1992: 146-147; Ohlin 1933: 55)?

In addressing these questions, my research findings show that the arguments of the competitiveness literature need to be qualified in three respects. Firstly, while the literature is right in suggesting that finance provided by *external* investors (i.e. creditors and shareholders) significantly facilitates the pursuit of specific strategies, it is wrong in its *detailed hypothesis* on

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[21] In line with Steeck and Thelen (2005: 9-16), I understand institutions as 'formalized rules that may be enforced by calling upon a third party' (Streeck and Thelen 2005: 10).

[22] As pointed out in chapter 1 (section 1.4.), a large number of input factors exist which may potentially facilitate the pursuit of a competitive strategy (see e.g. Porter 1985: 85-86; 122; 343-350). To limit the scope of my research endeavour, I decided to focus on those three factors which the competitiveness literature judges decisive for the success of any competitive strategy, namely (1) *financial means*, (2) *labour qualifications*, and (3) new *component standards*. These factors are said to be decisive in that a firm cannot secure them on its own. Instead, finance, labour qualifications and new component standards are only provided following the successful solution of a coordination problem between a firm and other economic actors (see in particular Hall and Soskice 2001a: 6-7; see also Lundvall 1992a: 13-15; Andersen 1992: 68-69; Patel and Pavitt 1994: 91-92; Hollingsworth 2000: 627-628; 632; Porter 1990: 20). The provision of *finance*, around which the analyses of this chapter are centred, depends on the successful solution of the *principle-agent problem* between a firm and its financiers (Mayer 1998: 145-146; Vitols 2001: 337; Kenyon and Vitols 2004: 11). Section 2.2. will elaborate on this coordination problem and illustrate how different solutions provide different types of finance.

[23] I took the decision to distinguish between *three* competitive strategies on the grounds of deductive reasoning, as well as an in-depth review of the competitiveness literature (see e.g. Ohlin 1933: 7; Sinn 2005: 18-19; Lundvall 1992b: 11-12; 57-59; Freeman 1992: 182; Porter 1990: 10; 37; Hall and Soskice 2001a: 38-39; Estevez-Abe et al. 2001: 148-149; 174-175; Casper 2001: 398-400). My assumption that a distinction between three strategies is both sufficient and necessary was empirically confirmed *ex post* by the fact that I could attribute one strategy to each firm of the sample (see chapter 1; section 1.3.2.). Furthermore, operational differences between the three groups of firms turned out to be statistically significant in that each strategy requires specific input factors. Thus, the decision to distinguish between three strategies is justifiable both from a theoretical and an empirical perspective.

debt finance (see Vitols 2001: 352; CPB Netherlands 1997: 353-354; Hollingsworth 2000: 628): Diversified Quality Producers and Low Cost Producers do not finance their activities from debt any more than Radical Product Innovators do. Quite the opposite is the fact: I found firms pursuing an RPI strategy to rely on debt finance more heavily than firms pursuing a DQP and an LCP strategy.

Secondly, and more importantly, the idea that *insider* share capital furthers Diversified Quality Production, whilst *outsider* shareholder funds facilitate RPI, is not supported empirically (Vitols 2001: 350; 359-360; Hall and Soskice 2001a: 27; 39-41; CPB Netherlands 1997: 354-356; Bronk 1998: 14-15). Instead, empirical evidence suggests that a distinction between share capital provided by *institutional* investors on the one hand, and by *private* investors on the other, is more viable to explain differences in the pursuit of competitive strategies. Whilst Radical Product Innovators rely heavily on institutional share capital, Diversified Quality Producers tend to use privately owned shareholder investment as a source of finance.

Thirdly, and in my view most importantly, the competitiveness literature must be criticised for its exclusive analytical focus on *national* institutions which, in turn, leads to the misconception of entrepreneurs as mere institution-takers (see Hall and Soskice 2001b in general; and Hall and Soskice 2001a: 56 in particular; see also Porter 1990, chapter 3; Ohlin 1933: 7; 55). It is both correct and noteworthy that country-specific regulation facilitates the emergence of specific types of finance. Accordingly, the (still) rather generous *public* pension and insurance systems in Germany and Italy lead to a lower number of institutional investors than in the UK. However, the fact that fewer institutional investors exist in Germany and Italy does not mean that German and Italian entrepreneurs are unable to pursue an RPI strategy. Instead, I illustrate that Radical Product Innovators in Germany and Italy acquire share capital from *foreign* institutional investors. In other words, entrepreneurs circumvent national regulations by importing the required input factors from abroad, thereby drawing on international institutions. Thus, contrary to the perception of the competitiveness literature, entrepreneurs are not mere institution-takers. Instead, I find a Schumpeterian approach, which perceives entrepreneurs as independent and inventive actors (see e.g. Schumpeter 1934, chapter 4),(Schumpeter 1942: 81-106) more instructive for understanding how firms can pursue the same variety of competitive strategies within the same economy.

To illustrate this argument, the remaining parts of this chapter are organised as follows. In section 2.2., I introduce the hypotheses of the competitiveness literature on the link between corporate-governance regulations, financial input factors, and competitive strategies. I test these hypotheses in section 2.3. and 2.4.. In so doing, section 2.3. asks whether financial means

provided by external investors actually facilitate competitive strategies significantly more than potential rival factors. Finding this to be the case, section 2.4. studies which (national) institutions provide those financial means which are required for a specific strategy. Section 2.5. concludes by elaborating on the implications of the previous findings.

2.2. The Hypotheses of The Competitiveness Literature: How different Corporate-Governance Regulations provide Finance for different Competitive Strategies

The decision to limit my analyses to three input factors was grounded on the argument of the competitiveness literature that (1) finance, (2) labour qualifications, and (3) standards are decisive for the success of any competitive strategy (see in particular Hall and Soskice 2001a: 6-7; see also Lundvall 1992a: 13-15; Andersen 1992: 68-69; Patel and Pavitt 1994: 91-92; Hollingsworth 2000: 627-628; 632; Porter 1990: 20). The reason for their decisive role is that a firm cannot secure these factors on its own. Instead, they are provided only following the solution of a coordination problem between a firm and other economic actors (Hall and Soskice 2001a: 6). With regard to finance, a coordination problem arises whenever a firm seeks to acquire capital from external investors (Hall and Soskice 2001a: 7). More precisely, a *principle-agent problem* emerges in that the interests of the firm's managers (agents) can differ substantially from the interests of its investors (principals) (Mayer 1998: 145-146; Vitols 2001: 337; Kenyon and Vitols 2004: 11). As a rule, investors want to be assured that their money is used in such a way that it yields the highest possible return on investment. Managers, instead, 'may indulge in empire-building, which includes investments in large offices, in staff departments or in R&D activities, launching of over-extensive advertising campaigns or acquisitions' (CPB Netherlands 1997: 347). Thus, the coordination problem, related to the provision of finance, consists in finding mechanisms that keep managers in check by aligning their interests with those of external investors.

Two ways exist in which this principle-agent problem can be resolved, as investors have two possibilities for making sure that their funds are used efficiently: by determining the returns on their investment *ex ante*, or by preserving the right to participate in the decision-making on how their funds are used. Whilst the provision of *debt finance* is typically made dependent on the former type of agreement, the provision of *share capital* is made dependent on the latter. But how can these two types of finance facilitate the pursuit of different competitive strategies?

Various authors suggest that *debt finance* promotes both DQP and LCP, whereas it forecloses the pursuit of an RPI strategy (Vitols 2001: 352; CPB Netherlands 1997: 353-354;

Hollingsworth 2000: 628; see Bronk 1998)[24]. The reason for this is straightforward. Debt finance is provided on the condition that the creditor and the borrower agree on an amount of money, the sum of interests, which the borrower has to pay back in addition to the loan granted. Since the return on investment is fixed from the outset, the creditor cannot achieve a higher return on her investment than the invested amount itself, increased by the sum of interests. Thus, to safely recover their funds, creditors are risk-averse. Instead of investing in risky RPI projects where the danger of failure is high, they prefer to invest in DQP or LCP projects which promise secure returns (CPB Netherlands 1997: 346). Thus, whenever a firm relies to a large extent on debt finance, it is unlikely to pursue an RPI strategy but is, presumably, engaged in DQP or LCP (CPB Netherlands 1997: 353-354).

To illustrate the hypotheses on how *share capital* furthers different competitive strategies, it is necessary to distinguish between *insider share capital* on the one hand, and *outsider share capital* on the other. As mentioned above, shareholders provide money to a firm on the condition that they are granted a say in how their funds are spent. The distinction between insider and outsider shareholder finance refers to the extent to which shareholders can influence management decisions on major financial issues.

In *insider systems*, shareholders elect a supervisory board which, in turn, exerts control over the management board. This supervisory board comprises representatives of both shareholders and employees. It may or may not have the power to appoint managers. More importantly, though, the members of the supervisory board have *inter alia* the right to approve major investment decisions, to control the annual statement of accounts, and to consult the firm's management in major corporate affairs. Thus, shareholders in insider systems not only acquire considerable insight into how a firm is run, they also have notable decision-making power in all major financial issues (CPB Netherlands 1997: 350-351; 357-362).

By contrast, in *outsider systems* shareholders merely elect the firm's management. They do *not* elect a supervisory board which would, in turn, participate in the decision-making process on major corporate affairs. To monitor whether their funds provide an acceptable return on investment, shareholders are therefore limited to consulting 'outsider' information, such as publicly available accounting indicators (e.g. the firm's balance sheet or the performance of the firm's stocks at the stock market). If these accounting indicators and, hence, the return on investment are disappointing, shareholders may decide to rapidly exit the company by selling

[24] It should be noted that the competitiveness literature does not make any explicit suggestions regarding the type of finance which facilitates an LCP strategy. However, extending the reasoning of the literature to Low Cost Production, it is possible to propose arguments with regard to the type of finance that facilitates or hampers this strategy.

their shares. They have no other means to ensure that managers use the capital provided in a profitable way. Outsider control mechanisms therefore oblige managers to maximise shareholder value and to focus on the short-term performance of their firm's shares (Bronk 1998: 5; CPB Netherlands 1997: 348-350).

But how do outsider share capital (i.e. share finance provided by shareholders in outsider systems) and insider share capital (i.e. share funds provided by shareholders in insider systems) impact on different competitive strategies? The competitiveness literature argues that insider share capital furthers Diversified Quality Production, whilst outsider share capital is assumed to facilitate Radical Product Innovation (Vitols 2001: 350; 359-360; Hall and Soskice 2001a: 27; 39-41; CPB Netherlands 1997: 354-356; Bronk 1998: 14-15; see Lindgaard Christensen 1992: 162).

The reason for which insider shareholder finance is said to promote DQP is based on the idea that pronounced shareholder control rights encourage actors with a particular interest in a firm to acquire a comparatively large number of shares. Indeed, the firm's founding family, banks, suppliers, and processors are often major shareholders in companies in insider systems (Bronk 1998: 11-12; Mayer 1998: 158-159; Kenyon and Vitols 2004: 17-18). This is said to facilitate Diversified Quality Production for three reasons. Firstly, the fact that banks, suppliers and processors – together with employee representatives – are strongly represented on the firm's supervisory board furthers long-term, trust-based relations between the firm and its major stakeholders. The reason for this is that the latter, being members of the supervisory board, can make sure that their relations with the firm are not immediately cut-off in periods of economic downturn. Thus, whenever a firm finds itself in economic difficulty, the supervisory board members supposedly discourage the management from immediately dismissing employees, or switching to cheaper suppliers (Bronk 1998: 14). On the one hand, this motivates employees to acquire firm-specific skills. On the other hand, it strengthens the link between the firm and its suppliers, thereby increasing their willingness to contribute to the firm's quality management. At the same time, however, long-term relations make it difficult to oblige suppliers to deliver at the lowest possible prices. Similarly, long-term relations between a firm and its employees prevent the latter from acquiring field-specific skills. In brief, insider shareholder finance furthers the emergence of labour qualifications (see chapter 4) and supplier-producer relations (see chapter 3) which are said to be crucial for the pursuit of a DQP strategy, but which militate against RPI and LCP (Bronk 1998: 14; Hall and Soskice 2001a: 39; Mayer 1998: 159-160).

The second reason for which insider shareholder finance furthers DQP is a corollary of the first. Since employees, the founding family, banks, suppliers, and processors alike have important

commercial relationships with 'their' firm, they have a vested interest in its persistence. Therefore, they prefer production strategies with secure returns to high-risk strategies. Accordingly, block shareholders are rather risk-averse and do not force managers to divest rapidly from unprofitable business units (CPB Netherlands 1997: 353-354). Finally, since the firm's major shareholders are often active in the same or related industries, they can significantly increase the firm's knowledge of the market. While banks help to evaluate investment projects, suppliers provide valuable information about technological development and niche markets. This, in turn, makes business activities in high-quality segments particularly attractive, whereas the wholesale shift from existing to radically new production activities becomes less appealing (Bronk 1998: 14).

In contrast to insider share capital, *outsider share capital* is assumed to further RPI. I have already illustrated that the reduced monitoring capacities of shareholders in outsider systems obliges managers to focus on the maximisation of shareholder value. The predominant concern of managers to maximise shareholder value is said to promote RPI for three reasons. Firstly, shareholder value is maximised whenever managers successfully pursue high-risk, high-return strategies. Shareholders, presumably, also favour the pursuit of an RPI strategy because 'the costs of bankruptcy in case of total failure of high-risk strategies are divided between shareholders and creditors' (CPB Netherlands 1997: 346). Secondly, since shareholders in outsider systems have no say in how their money is used, managers are highly autonomous when taking investment decisions. Accordingly, they can rapidly reallocate resources to those radically innovative projects which promise the highest returns. This, in turn, is incompatible with the pursuit of long-term oriented low-risk, low-return strategies, i.e. DQP and LCP (CPB Netherlands 1997: 348). Finally, outsider shareholder finance hinders the development of long-term, trust-based relationships between a firm and its employees on the one hand, and its suppliers on the other. The reason for this is that, in order to maintain shareholder value, managers are obliged to dismiss employees and to look for cheaper suppliers as soon as company sales start to decline. In outsider systems, employees are thus discouraged to acquire firm-specific skills, whilst suppliers are reluctant to cooperate closely in a firm's quality management (Bronk 1998: 7; CPB Netherlands 1997: 352-353). Thereby, outsider shareholder finance hinders the development of labour qualifications (see chapter 4) and supplier-producer relations (see chapter 3) which are crucial for the successful pursuit of a DQP strategy.

To recapitulate, the competitiveness literature hypothesises that the pursuit of an RPI strategy is facilitated by outsider share capital, whereas DQP is promoted by both debt finance and insider share capital. The pursuit of an LCP strategy, in turn, would appear to rely on a

comparatively high level of debt finance (Vitols 2001: 350-352; 359-360; Bronk 1998; Hall and Soskice 2001a: 27; 39-41; CPB Netherlands 1997: 353-354; see Lindgaard Christensen 1992: 162; Ohlin 1933: 7; 55). Table 2.1. provides an overview of the hypotheses regarding the impact of finance on each competitive strategy. It is the aim of the two following sections to test these hypotheses.

Table 2.1.: Hypothetical Relationships between Finance and Competitive Strategies

Input Factor / Production Strategy	Finance		
	Debt Finance	Share capital	
		Outsider ShC	Insider ShC
1. Radical Product Innovation		X	
2. Diversified Quality Production	X		X
3. Low Cost Production	X		

2.3. Testing the Hypotheses on Different Financial Means: Do Specific Strategies require Specific Means of Finance?

In the following section, I test the first part of the hypotheses which I derived from the competitiveness literature as laid out in section 2.2.. Accordingly, I assess whether each competitive strategy actually relies on specific types of finance. In so doing, I reveal to what extent firms finance their activities from debt on the one hand, and from share capital on the other. However, I do not assess in section 2.3. whether specific *types* of share capital facilitate specific strategies. This assessment is reserved for section 2.4., as it is closely linked to the question of whether national corporate-governance institutions provide specific financial means.

Before starting the empirical assessments, I wish to stress that the following analyses are based on two sources of information. While I predominantly studied balance sheet data, I also carried out about 20 in-depth interviews with company representatives and financial experts in Germany, Italy and the UK[25]. These interviews provided me with important background information and a general understanding of how specific types of finance impact specific

[25] The questionnaire I used as a guideline when talking to employees of the firms' Finance Departments is reproduced in the appendix.

competitive strategies. To reveal the extent to which firms rely on different types of finance, I analysed the balance sheets of 74 pharmaceutical firms in Germany, Italy the UK.[26]

Before presenting the results of these analyses, it is useful to say a few words about how I arrived at the final firm sample. Let me repeat that the initial sample, obtained from the sampling strategy described in chapter 1, was composed of 93 firms (see section 1.3.2.). In studying these companies more closely, it came to light that in the course of the last few years some had gone bankrupt (namely *Axis Genetics*, and *Virogen*), whilst others had merged or been acquired (namely *Imperial Cancer Research*, *KS Biomedix*, *Nycomed Amersham*, *Amersham Pharmacia Biotech*, *Bioglan*, *Oxford Glyco Sciences*, *Plantorgan*)[27]. In a limited number of cases, it was impossible to identify the firm as denominated in the PHID sample (namely *Scotia*, *Biopharm (UK)*, *GLE Medicon*, *Ausonia*, *Bruno*, and *Biotoscana*). This shrunk the initial sample from 93 to 78 cases. In about 30% of these 78 remaining cases it was not possible to obtain financial data. This constituted a problem in that the number of cases became almost too small for carrying out quantitative analyses.

However, the initial sample was limited, for good reasons, in two respects. Firstly, it did not include any generics firms. As explained in chapter 1 (section 1.3.1.), a firm is only included in the PHID database if it has participated in a pharmaceutical project that has reached the stage of pre-clinical development. Generics firms, imitating a once patent-protected drug, are not required to perform any clinical trials as long as they can demonstrate that the imitated drug is bioequivalent to the original pharmaceutical. Since generics firms do not engage in R&D, they are not recorded in the PHID database which, in turn, shows that they actually pursue an LCP strategy. Secondly, the initial firm sample contained only a limited number of biotech firms for both Germany and Italy. The reason for this is that the biotech industry is notably younger in Germany and Italy than in the UK. Since many biotech firms in Germany and Italy were founded in the late 1990s, they have not yet brought any pharmaceutical project beyond the stage of pre-clinical development. Accordingly, they were not yet included in the PHID database when I sampled the latter in November 2004. As a result, the sample contains comparatively few German and Italian biotech companies.

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[26] As discussed in chapter 1 (section 1.3.1.) the term *pharmaceutical firm* is used as a generic term for all types of companies which are active in the drug industry, i.e. for biotech-, traditional pharmaceutical-, and generics firms alike.

[27] In addition, another 11 companies merged or were acquired before or during the period of data collection (i.e. to April 2006), namely *Celltech*, *Pharmagene*, *PowderJect*, *Xenova*, *Galen*, *British Biotech*, *ASTA Medica*, *Jenapharm*, *Rotta Research*, *Formenti* and *Rottapharm*. However, contrary to the aforementioned companies, I could obtain data for the latter firms because of one of the following two reasons. Either the merger/acquisition only constituted a formal change of shareholder majorities without entailing major changes in the firm's organizational structure, and/or the merger/acquisition was completed after my interview with the firm in question.

In order to obtain a more homogenous case sample on the one hand, and to increase the number of cases on the other, I added both generics and biotech firms to the sample. In so doing, I made the utmost effort to proceed in a consistent way. With regard to ***generics producers***, I added only those firms which can be said to be typically British, German or Italian in that firms have their headquarters in, and concentrate their (development) activities on the national territories of one of these three countries. Accordingly, I added 6 generics producers to the British sample (namely *CP Pharmaceuticals*[28], *Generics (UK)*[29], *Kent Pharmaceuticals*, *Sussex Pharmaceuticals*, *Tillomed Laboratories* and *Sterwin Medicines*[30]), and 9 generics firms to the German sample (namely *Aliud Pharma*, *Betapharm Arzneimittel*[31], *CT Arzneimittel*, *Hexal*[32], *Lichtenstein Pharmazeutica*[33], *Merck Dura*, *Ratiopharm*, *Azupharm*[34], and *Stada Arzneimittel*). It is important to note that it was difficult to add generics producers to the Italian sample. Due to the rather strict price floors imposed on pharmaceutical products by the Italian government, a genuine Italian generics industry does not exist (Magazzini et al. 2002; Wittner 2003: 130-134). Most generic drugs sold in Italy are imported by foreign generics producers (Orsenigo 2004; Wittner 2003: 133-134). However, *DOC Generici* and *Dorom*[35] constitute two exceptions as they have genuine Italian roots. Accordingly, I decided to incorporate them in the sample.

Since ***biotech firms*** are already highly present in the British firm sample, I added only German and Italian biotech companies. Aiming to minimise the risk of bankruptcy, I included only particularly successful German and Italian biotech firms. Hence, I added the *oldest*, the *largest* (expressed in number of employees) and the *most successful companies* (measured in terms of annual turnover). In so doing, the German firm sample was enlarged by 3 firms (namely

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[28] While *CP Pharmaceuticals* was acquired by *Wockhardt* in 2003, the original structure was still intact at the time of my interviews.

[29] *Generics (UK)* was acquired by *Merck KGaA* in 1994. However, this acquisition lead only to a change in shareholder majorities and had no major effects on the company's organisation. Accordingly, the 'typically British' *modus operandi* remained in place.

[30] While *Sterwin Medicines* was renamed *Winthrop Pharmaceuticals* in December 2004, this did not entail any major restructuring. Hence, the original structure was still intact at the moment of data collection.

[31] It should be noted that *Betapharm* was acquired by a group of investors, *3i*, in March 2004. However, this acquisition merely constituted a change of shareholder majorities, and Betapharm's structure was (still) unchanged when I carried out interviews.

[32] In 2005, *Hexal* was acquired by *Novartis*. Importantly, though, I could collect data and carry out interviews before that time.

[33] While *Lichtenstein Pharmazeutica* was transformed into *Winthrop Arzneimittel* in January 2005, it continued to operate as an independent business unit. Hence, the former, 'typically German' *modus operandi* was still in place when I interviewed representatives.

[34] In January 2004, *Azupharm* merged with *Biochemie Pharma* to form the *Sandoz GmbH*. Despite this merger, Ex-*Azupharm* continued to operate as an independent business unit. Consequently, the former, 'typically German' *modus operandi* was still in place when I interviewed representatives of this company.

[35] Although *Teva* acquired *Dorom* in 2004, this acquisition only led to minor restructuring processes, and the organisational structure was (still) intact when I interviewed representatives.

DeveloGen, *Ingenium Pharmaceuticals*, and *Sirenade*[36]), while the Italian sample was increased by 8 companies (namely *Axxam*, *BioXell*, *Newron Pharmaceuticals*, *Nikem Research*, *Novuspharma*[37], *Primm*, *Shar.dna*, and *Siena Biotech*). In contrast to generics firms, whose competitive strategy consists by definition of LCP, the competitive strategy of biotech companies is more difficult to identify because many, although not all, pursue an RPI strategy. I therefore identified the competitive strategy of each biotech firm added on the basis of four different sources, namely their classification as worked out by (1) *Ernst and Young* on the one hand (Ernst&Young 2002: 15-19)[38], and (2) by *Knut Lange* on the other (Lange 2006)[39]. Furthermore, I consulted (3) the firms' *web-pages* about their business strategies, and (4) I asked my *contact partners* during interviews about their firm's strategy.[40]

In so doing, I increased the 78 remaining cases of the initial sample to 106. It may be interesting to note that this firm sample has undergone some final modifications, as the competitive strategies of those 9 firms which were classified in chapter 1 (section 1.3.2.) as both RPIs and DQPs had to be clarified. For four firms (*ASTA Medica*, *Boehringer Ingelheim*, *Bracco* and *Menarini*), I could obtain separate data for the respective RPI and DQP business units. Accordingly, I considered each of the two business units as a single case. In the five other cases (*Astra Zeneca*, *Bayer*, *GlaxoSmithKline*, *Schering*, and *Shire*), I could only obtain data for one business unit. Hence, I assigned just one strategy on the basis of the interviews I carried out with firm representatives. This, in turn, left me with a final sample of 110 cases.

Admittedly, the above explanations might read ponderously. However, the patient reader will, hopefully, benefit from understanding how the sample is ultimately composed, because the latter will serve as the basis for all furthur analyses – on finance, labour qualifications and component standards alike. For the following analyses on how finance impacts competitive strategy, I was able to obtain balance sheet data for 74 cases. Let us therefore finally try and shed light on our initial question: does empirical evidence support the hypothesis that each competitive strategy relies on specific types of finance?

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[36] At the time of my interview, the future acquisition of *Sirenade* by *Crelux* in 2005 was already decided. However, a possible restructuring process had not yet started.

[37] Although *Novuspharma* became a wholly owned subsidy of *Cell Therapeutics* in 2003, it continued to operate as an independent business unit. Hence, the 'typical Italian' way of organising business was (still) intact when I interviewed firm representatives.

[38] I am grateful to Julia Schüler for forwarding the list of biotech firms which have been classified by Ernst&Young as 'TechProduct Companies' on the one hand, and as 'Product Companies' on the other (Ernst&Young 2002: 15ff.).

[39] I wish to thank Knut Lange for the fruitful discussions about the British and German biotech industry in general, and about the classification of biotech firms as RPIs or DQPs in particular.

2.3.1. SOME TENTATIVE OBSERVATIONS

When looking at a firm's balance sheet, we see that – apart from *debt finance* and *share capital* – the firm can use three other sources of finance. Firstly, it can resort to *retained earnings*. At the end of each accounting period, a firm's shareholders must decide what to do with the profits of that period. Shareholders have two options: either they can choose to distribute their profits, or they can decide to retain them in the company as a reserve for financing future activities[41]. Hence, retained earnings constitute that amount of profits (or losses) which a firm's shareholders decided to retain over past accounting periods. Secondly, a firm can use *short-term liabilities*. Short-term liabilities constitute those liabilities with a duration of less than 1 year which arise from a firm's daily business. Examples are supplier credits, taxes and social expenditure to be paid, as well as short-term debt (resulting for example from the overdraft of a company's current accounts)[42]. Finally, a firm can resort to so-called *other non-current liabilities*. This term denominates those funds which a company keeps aside whenever it is concerned that it may have to pay an outstanding amount of money in the future. Pension provisions, provisions for doubtful debts, provisions for outstanding claims, and deferred taxes constitute some of the most prominent examples.

If the hypotheses of the competitiveness literature hold true, we should find that – of the five financial resources (*share capital*, *long-term debt*, *retained earnings*, *short-term liabilities*, and *other non-current liabilities*) – Radical Product Innovators use a comparatively high level of share capital (Vitols 2001: 350; 359-360; Hall and Soskice 2001a: 40; CPB Netherlands 1997: 354-355; see CPB Netherlands 1997: 146-147; 162; Ohlin 1933: 7; 55), while Low Cost Producers rely on a rather high amount of long-term debt (see Vitols 2001: 352; CPB Netherlands 1997: 353-354). Diversified Quality Producers, in turn, should use a comparatively high amount of both share capital and long-term debt (Vitols 2001: 350; 352; 359-360; Hall and Soskice 2001a: 27; 39-41; CPB Netherlands 1997: 353-354; 355-356; Hollingsworth 2000: 628; see Lindgaard Christensen 1992: 146-147; 162; Ohlin 1933: 7; 55). More precisely, the following analyses should show that Radical Product Innovators (RPIs) use roughly the same amount of

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[40] Based on these insights, I classified *DeveloGen*, *Ingenium Pharmaceuticals*, *Sirenade*, *BioXell*, *Newron Pharmaceuticals*, *Novuspharma*, *Shar.dna*, and *Siena Biotech* as RPIs. By contrast, *Axxam*, *Nikem Research*, and *Primm* were classified as DQPs.

[41] Of course, shareholders can decide to do both: distribute one part of the profits and retain the other as a reserve.

[42] It should be noted that debt finance consists of both *short-term debt* (i.e. loans to be repaid within less than one year) and *long-term debt* (i.e. loans to be repaid within more than one year). Yet, the hypotheses of the competitiveness literature regarding the impact of debt finance on competitive strategy refer only to long-term debt (see section 2.2.). The reason for this is that creditors do usually not make an in-depth assessment of a firm's activities (and, hence, of its competitive strategy) before granting a short-term loan. Therefore, I included all short-term debt in the firm's short-term liabilities, while I considered only long-term debt as debt finance.

share capital as Diversified Quality Producers (DQPs). Yet both RPIs and DQPs should use significantly more share capital than Low Cost Producers (LCPs). Similarly, DQPs should rely on long-term debt to roughly the same extent as LCPs. However, both DQPs and LCPs should use more long-term debt than RPIs.

To reveal the extent to which firms rely on different sources of finance, I subdivided the debit side of each of the 74 available balance sheets into their five financial components. In order to control for temporary peaks, I determined all figures as an average of the last five available years (usually 1999 – 2003). In so doing, I determined what percentage of a firm's overall capital is made up of *share capital*, *retained earnings*, *long-term debt*, *other non-current liabilities* and *short-term liabilities*. Table 2.2. presents an overview of the capital composition of the various subgroups of the 74 companies. While the sum of share capital and retained earnings constitutes a company's equity capital (*Eigenkapital*), the sum of long-term debt, other non-current liabilities and short-term liabilities represents a firm's borrowed capital *(Fremdkapital)*.

Table 2.2.: Capital Composition of Diverse Groups of Pharmaceutical Firms

Group of Firms	Nb. of Cases	Equity Capital		Borrowed Capital		
		Share capital	Retained Earnings	Long-term Debt	Other n.-c. Liabilities	Short-term Liabilities
Average RPIs UK	10	**254 %**	**-200 %**	**18 %**	**2 %**	**26 %**
Average DQPs UK	12	**44 %**	**11 %**	**8 %**	**6 %**	**31 %**
Average LCPs UK	7	**1 %**	**41 %**	**4 %**	**4 %**	**50 %**
Average Biotechs UK	15	195 %	-136 %	14 %	4 %	23 %
Average Tr.Pharmas UK	8	21 %	23 %	8 %	5 %	43 %
Average Generics UK	6	1 %	42 %	4 %	5 %	48 %
Average RPIs Ger.	5	**103 %**	**-38 %**	**10 %**	**11 %**	**14 %**
Average DQPs Ger	8	**13 %**	**34 %**	**8 %**	**24 %**	**21 %**
Average LCPs Ger	4	**6 %**	**28 %**	**14 %**	**13 %**	**39 %**
Average Biotechs Dtl.	4	123 %	-55 %	11 %	9 %	12 %
Average Tr.Pharmas Dtl.	9	14 %	33 %	8 %	24 %	21 %
Average Generics Dtl.	4	6 %	28 %	14 %	13 %	39 %
Average RPIs It.	8	**45 %**	**-1 %**	**18 %**	**4 %**	**34 %**
Average DQPs It.	13	**12 %**	**29 %**	**7 %**	**8 %**	**44 %**
Average LCPs It.	7	**5 %**	**11 %**	**7 %**	**14 %**	**63 %**
Average Biotechs It.	9	39 %	6 %	11 %	5 %	39 %
Average Tr.Pharmas It.	17	11 %	20 %	11 %	8 %	50 %
Average Generics It.	2	6 %	29 %	6 %	27 %	32 %
Overall Average RPIs	23	**149 %**	**-96 %**	**16 %**	**5 %**	**26 %**
Overall Average RPIs	33	**24 %**	**23 %**	**8 %**	**12 %**	**33 %**
Overall Average RPIs	18	**4 %**	**26 %**	**7 %**	**10 %**	**53 %**
Overall Average Biotechs	28	134 %	-79 %	13 %	5 %	27 %
Overall Average Tr.Phar.	34	14 %	24 %	9 %	12 %	41 %
Overall Average Generics	12	3 %	36 %	8 %	11 %	42 %

Table 2.2. points to two trends which are of particular interest for all further analyses. Firstly, variations in the extent to which firms rely on different sources of finance are strikingly homogenous for the *strategy* and *industry* subgroups of firms. In other words, firms which pursue a specific strategy, and firms which are active in a specific industry, show very similar attitudes with regard to the financial resources on which they rely most heavily. This suggests that a firm's competitive strategy and its industry have a fairly similar impact upon its financial decisions.

Secondly, while country-specific variations in the *absolute* use of specific financial means can be observed, both Radical Product Innovators and Low Cost Producers rely on one type of finance *relatively* more than on any of the other financial sources – irrespective of the country in which they are based. Accordingly, share capital constitutes the most important source of finance

for the pursuit of an RPI strategy in the UK, in Germany, and in Italy alike. Similarly, British, German and Italian Low Cost Producers use short-term liabilities more than any other type of finance. This suggests that different competitive strategies do indeed rely on different types of finance.

At first sight, Diversified Quality Production seems to constitute an exception to this rule, because it depends on the country whether firms use *share capital*, *retained earnings*, or *short-term liabilities* as their most important means of finance. Does this indicate that a DQP strategy can be pursued irrespective of the specific type of finance? To avoid confusion, I want to point out here what the following analyses will reveal: akin to RPI and LCP, a DQP strategy is also facilitated by a specific means of finance. However, this trend does not emerge clearly from table 2.2. because of different accounting rules used in the UK and Italy on the one hand (namely the *IAS*, and sometimes the *US-GAAP*), and in Germany on the other (namely accounting rules according to the *HGB*). While the accounting system according to HGB obliges firms to report the full amount of pension provisions in their balance sheets, the IAS and the US-GAAP allow the outsourcing of pension provisions to individual pension funds (Schneck 1998: 551-552). Accordingly, table 2.2. shows that other long-term liabilities, which include a firm's pension provisions, constitute a particularly important means of finance for German firms in general, and for German DQPs in particular. The reason for this is that DQPs are significantly older than LCPs and RPIs (see section 2.3.2.2.). Therefore, DQPs in Germany have often accumulated a substantial amount of pension provisions, which is reflected by table 2.2. in that it shows other long-term liabilities to be the second most important source of finance for German DQPs. The relative importance of long-term liabilities for German DQPs obscures the overall picture. Since the five means of finance add up to 100% of a firm's capital, they deprive each other of their relative explanatory power because an increase in one item of the balance sheet necessarily leads to a relative decrease on the other items.

It should be noted that all the trends revealed in table 2.2. – regarding the three competitive strategies in general and DQP in particular – are speculative to the extent that they are grounded on average observations rather than on quantitative analyses. To assess whether trends are empirically significant, diverse quantitative analyses need to be carried out. I will present the results of these analyses in the course of the following sections. Will empirical evidence confirm the hypotheses of the competitiveness literature that share capital facilitates RPI and DQP, whereas debt finance is essential for the pursuit of LCP and DQP (Vitols 2001: 350; 352; 359-360; Hall and Soskice 2001a: 27; 39-41; CPB Netherlands 1997: 353-354; 355-356; Hollingsworth 2000: 628; see Lindgaard Christensen 1992: 146-147; 162; Ohlin 1933: 7; 55)?

2.3.2. CONTROLLING FOR PREDICTORS OF COMPETITIVE STRATEGIES OTHER THAN FINANCE.

To test the importance of specific types of finance for a firm's strategy, we must first assess to what extent rival explanatory factors exist. If one (or more) other factor(s) further(s) a competitive strategy more than specific financial input factors, an entrepreneur will tend to choose the former in order to pursue the strategy in question. In other words, it can only be claimed legitimately that specific types of finance are indispensable for a competitive strategy if they have a more decisive impact on this than any rival explanator. Needless to say, a large number of factors exist which may have some impact on a firm's strategy. Apart from the three input factors retained to be decisive by the competitiveness literature (see in particular Hall and Soskice 2001a: 6-7; see also Lundvall 1992a: 13-15; Andersen 1992: 68-69; Patel and Pavitt 1994: 91-92; Hollingsworth 2000: 627-628; 632; Porter 1990: 20), three other factors can be assumed to be of particular importance, namely: (1) the *country* in which a firm is based, (2) the *industry* in which a firm is active, and (3) a firm's *age*.

As laid out in chapter 1 (section 1.1.), it is a central claim of the competitiveness literature that the *country* in which a firm is based determines its choice of competitive strategy because national institutions limit the range of available input factors (see Heckscher 1919; Ohlin 1933; Sinn 2005; Porter 1990; Freeman 1992; Lindgaard Christensen 1992; Nelson 1993; Hollingsworth 2000: 626-630; see in particular Hall and Soskice 2001a: 38-44; Estevez-Abe et al. 2001: 174-176; Vitols 2001: 350-360; Tate 2001: 442-455). The introductory chapter suggests this argument to be wrong: we have seen that firms in different economies resemble each other in their choices of competitive strategy (see also chapter 5). However, since this claim is central to the competitiveness literature, I will test to what extent a firm's strategy correlates with the country in which it is located. If the literature is right, we should find that entrepreneurs choose a certain country rather than a certain type of finance to pursue the strategy in question.

Furthermore, table 2.2. suggests that the *industry* in which a firm is active has a pronounced impact on the means of finance a company prefers to use. Hence, it should also be assessed to what extent the industry within which a firm is active impacts on its strategy. If an industry facilitates the pursuit of a given strategy more than a firm's financial means, the former should be more strongly correlated with competitive strategy than the latter. Hence, a firm's industry constitutes another factor for which the financial data needs to be controlled.

Finally, as mentioned in the introductory chapter (section 1.3.3.), Abernathy and Utterback show that radically new innovations do often not come from incumbent firms. They are instead proposed by small and comparatively young (start-up) companies which are outsiders to an industry (Utterback 1994: 90-101). The reason for this is that radical innovation often makes

existing products obsolete. Incumbent firms therefore hold little interest in pursuing a strategy which accelerates the decline of their own products (Utterback 1994: 160-165). Thus, young firm-age facilitates RPI because young companies usually have few or no product(s) that risk becoming obsolete if a radically new innovation is made. If this argument holds true, we should find that firm-age is more strongly correlated with competitive strategy than any of the finance variables. I will therefore assess the importance of *firm-age* as a third potential predictor of competitive strategy.

Ideally, all potential predictors of competitive strategy would be tested in one model. If possible, regression analyses would correlate a firm's *country*, *industry*, *age*, *share capital*, *retained earnings*, *long-term debt*, *other non-current liabilities* and *short-term liabilities* (independent variables) with *competitive strategy* (dependent variable). However, such analyses would hardly provide any instructive outcome. On the one hand, the independent variables under consideration are too numerous to produce any significant result. This is particularly true as the overall number of cases is rather low, namely 74. On the other hand, several independent variables presumably co-vary. This is, in particular, the case for the five financial indicators: given that they always add up to 100% of a company's capital, a decrease in one financial indicator necessarily entails an increase in one or more others. Hence, the more financial variables are included in a regression model, the more they deprive each other of their respective explanatory power. To circumvent these problems and to filter the most important predictors of competitive strategy, I will carry out two analytical steps. In the remaining parts of section 2.3.2., I will, firstly, identify the strongest rival hypothesis for the pursuit of a competitive strategy. Secondly, I will assess in section 2.3.3. whether this rival hypothesis explains the choice of competitive strategy better than specific financial input factors.

2.3.2.1. *INDUSTRY* AND *COMPETITIVE STRATEGY*: TWO PROXIES FOR THE SAME CONCEPT

It is the aim of the following two sections to identify the strongest explanatory factor for the pursuit of a competitive strategy apart from finance. Accordingly, I test how the three abovementioned predictors (*country*, *industry* and *firm-age*) impact on competitive strategy. To this end, I carried out twelve logistic regression analyses. To begin, I ran six *binary logistic regressions*. These analyses resembled each other in the choice of *country*, *industry*, and *firm-age* as independent variables. However, they differed with regard to the employed regression method,

and with regard to the way in which the dependent variable, *competitive strategy*, was coded.[43] Furthermore, I carried out six *multi-nominal logistic regressions*. In line with the binary analyses, these multi-nominal regressions were similar in the choice of independent variables (*country*, *industry* and *firm-age*), and differed with regard to both the regression method employed, and the competitive strategy used as a reference category.[44]

Interestingly, these twelve analyses show that the best predictor of competitive strategy is the *industry* in which a firm is active. This finding is in line with the first observation made on the basis of table 2.2. (see section 2.3.1.). The latter showed that variations in the financial data are strikingly homogenous for the data-split along the lines of the firms' competitive strategy, as well as the data-split along the lines of the firms' industry. This, in turn, indicates that the *strategy* and the *industry* variable are highly correlated. Indeed, two different types of analyses provide empirical support for this finding. Firstly, the results of the aforementioned multi-nominal analyses are always preceded by the warning that 'there is possibly a quasi-complete separation in the data'. Secondly, the results of a simple correlation analysis show that the strategy and the industry variable are strongly correlated ($R = 0.802$; $p < 0.01$). How can we make sense of this finding?

Let us recall that the dimension which underlies and therefore enables the distinction between different competitive strategies is a firm's *technology intensity*. Compared to Radical Product Innovation which is highly technology-intensive, Diversified Quality Production is less technology-intensive. The technology intensity of LCP, in turn, is even more limited. Nevertheless, it is important to note that a firm's *technology intensity* also constitutes the dimension which allows us to distinguish between different industries, i.e. between biotech firms, pharmaceutical companies, and generics producers. While biotech firms are highly technology-intensive, the technology intensity of pharmaceutical firms is reduced, whereas generics firms are not technology-intensive at all (see chapter 1: sections 1.3.1. and 1.3.2.). Furthermore, a firm's industry was even used as a measure to determine the competitive strategy of those companies which did not emerge as unambiguous RPIs or DQPs from sampling the PHID database (see chapter 1: section 1.3.2.). In other words, it seems that competitive strategy and industry are *two*

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[43] I used both the 'Enter' and a 'Stepwise' method (Forward: LR). Furthermore, I coded competitive strategies in three different ways: (1.) as *PRIness* (all RPIs were coded 1, whilst all DQPs and LCPs were coded 0), (2.) as *DQPness* (all DQPs were coded 1, whereas all RPIs and LCPs were coded 0), and (3.) as *LCPness* (all LCPs were coded 1 while all RPIs and DQPs were coded 0). By combining the 2 regression methods with the 3 ways of coding the competitive strategy, I carried out 6 binary regression analyses.

[44] Again, I used both the 'Enter' and a 'Stepwise' method (Forward Entry). While I chose RPI as reference category for the first pair of analyses, DQP constituted the reference category of the second regression-pair. Finally, I used LCP as reference category for the third pair of analyses. By combining the 2 regression methods with the 3 reference categories, I carried out 6 multi-nominal regression analyses.

different measures of the same concept, namely technology intensity. This idea is empirically supported by a reliability test which shows a firm's competitive strategy and its industry to be highly reliable measures of the same dimension: technology intensity (raw Alpha Cronbach = 0.889; standardised Alpha Cronbach = 0.890).

This finding suggests that a firm's industry constitutes an alternative *dependent* variable, rather than a *predictor* of competitive strategy. Accordingly, the question to be asked is not: does a firm's *industry* have a significant impact on *competitive strategy*? Instead, it is to be found out whether a firm relies on certain sources of finance as a result of its *competitive strategy*, or as a result of the *industry* in which it is active? In other words, we want to make sure that we do not explain which input factors are required by firms in a certain industry, but by firms which pursue a specific competitive strategy.

A MANOVA analysis is most adequate for testing whether different means of finance are required for the pursuit of different competitive strategies, or instead for being active in different industries. Accordingly, I carried out three MANOVA analyses, correlating several combinations of *finance variables* (as the models' independent variables) with *competitive strategy* and *industry* (as the models' dependent variables)[45]. At first sight, the results of all three analyses are consistent in that the respective independent variables seem to predict the firms' industry slightly better than the firms' competitive strategy. However, none of the industry-related results is significant at a *0.1 significance level*. The only results which are significant at this level show that different financial decisions (with regard to the amount of short-term liabilities employed) predict a firm's competitive strategy better than a firm's industry. This finding is reassuring, as it can be interpreted as confirming that firms resort to certain sources of finance because they pursue a certain competitive strategy, not because they are active in a specific industry.

2.3.2.2. *FIRM-AGE* AND *COUNTRY*: ONE SIGNIFICANT AND ONE INSIGNIFICANT FACTOR FOR COMPETITIVE STRATEGY

Having shown that a firm's choice of finance allows us to predict its strategy better than its industry, the industry variable can be excluded from all further analyses. Since this variable was strongly correlated with the strategy variable, it emerged not only as the strongest predictor

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[45] More precisely, I assessed the impact of three combinations of those (financial) variables which the following sections will reveal to be the strongest predictors of competitive strategy. Hence, MANOVA1 used *share capital*, *retained earnings*, *long-term debt*, and *short-term liabilities* as independent variables, whereas MANOVA2 regressed *share capital*, *retained earnings*, and *short-term liabilities*. In addition to the three strongest financial predictors of competitive strategy (*share capital*, *retained earnings*, and *short-term liabilities*), MANOVA3 also included *firm-age* as a fourth independent variable, since the latter turned out to be the strongest non-financial predictor of competitive strategy (see section 2.3.2.2.). In each MANOVA analysis, I correlated the respective independent variables with the two dependent variables, *competitive strategy* and *industry*.

of competitive strategy from the previous regression analyses, but also, presumably, reduced the explanatory power of the two other rival predictors. Hence, the twelve logistic regression analyses carried out in section 2.3.2.1. must be run again, with the difference that *industry* is removed as an independent variable from the various models. Thereby, only the explanatory power of *country* and *firm-age* is assessed.

Interestingly, the results of these analyses agree on two points. Firstly and for the aim of my study most importantly, they show without exception that the *country* in which a firm is based does *not* constitute a significant determinant of its competitive strategy. In none of the twelve analyses does the firms' country qualify as a significant strategy-predictor – not even at a significance level of 0.1. These results confirm the findings of the introductory chapter: firms pursue different strategies irrespective of the country in which they are based. This finding also indicates that the availability of input factors is not exclusively determined by national institutions in general, and corporate-governance regulations in particular. Since I will elaborate on this argument in section 2.5., suffice it to say here that entrepreneurs seem to have more freedom with regard to their choice of input factors than suggested by the competitiveness literature. Having found a firm's location not to have any significant impact on its strategy, I exclude the country variable from all further analyses.

Secondly, the results obtained also show that *firm-age* qualifies as a significant determinant of competitive strategy in almost all analyses. This result confirms Abernathy and Utterback's finding that radically innovative companies are younger than firms pursuing a DQP or an LCP strategy. As pointed out previously, these authors suggest that incumbent firms have difficulties in pursuing an RPI strategy because radical innovation often renders existing products obsolete (Utterback 1994: 160-165). Hence, incumbent firms have little interest in pursuing a strategy which accelerates the decline of their own products. In line with my quantitative findings, I conclude that firm-age facilitates RPI because young companies usually have few, or no product(s) that could become obsolete if a radically new innovation were to be made.

In sum, the previous analyses have shown *firm-age* to be the strongest predictor of competitive strategy. Consequently, and contrary to a firm's *industry* or *country*, I retain firm-age as a potential independent variable in order to assess, in the following analyses, whether it predicts a firm's strategy better than different types of finance.

2.3.3. How Specific Sources of Finance further Specific Competitive Strategies

The above analyses found empirical support for the argument that Radical Product Innovation is facilitated by a young firm-age (see Utterback 1994: 90-101; 160-165). Consequently, the question arises whether this finding can be reconciled with the argument of the competitiveness literature that specific means of finance further the pursuit of specific competitive strategies (Vitols 2001: 350-352; 359-360; Bronk 1998; Hall and Soskice 2001a: 27; 39-41; CPB Netherlands 1997: 353-354; see Lindgaard Christensen 1992: 162; Ohlin 1933: 7; 55). In other words, is a firm's competitive strategy facilitated by different financial means more than by its age? To answer this question, I run various binary and multi-nominal logistic regression analyses.

Before presenting these results, three technical remarks should be made. Firstly, let us recall that *share capital*, *retained earnings*, *long-term debt*, *other non-current liabilities* and *short-term liabilities* add up to 100% of a firm's capital. Consequently, at the very most four financial indicators can be introduced into one regression model as a predictor of competitive strategy. Otherwise the measurement is no longer independent. To allow for independent measurement, it was most advisable to exclude *other non-current liabilities* from the following analyses, for three reasons. First, as table 2.2. shows, other long-term liabilities do overall not only constitute the least important means of finance. The variation in the extent to which firms pursuing different strategies use this type of finance is also very narrow. This suggests that other long-term liabilities do not have a facilitative impact on any competitive strategy. Several multi-nominal logistic regression analyses confirmed that neither an RPI, nor a DQP, nor an LCP strategy requires this type of finance[46]. Second, let us recall our previous observation that German firms in general, and German DQPs in particular, employ more 'other non-current liabilities' than firms in Italy and the UK (see table 2.2. in section 2.3.1.). The reason for this is that German accounting rules according to HGB oblige firms to report pension provisions in their balance sheets. By excluding other non-current liabilities from the following analyses, this country-specific difference in accounting rules was given less weight. Finally, the competitiveness

[46] More precisely, I carried out three multi-nominal logistic regressions for each of the five financial indicators (*share capital*, *retained earnings*, *long-term debt*, *other non-current liabilities*, and *short-term liabilities*). Thereby, the first analysis of each trio used RPI, the second DQP, and the third LCP as a reference category. In each trio of analyses, I assessed the impacts of the respective *financial indicator* and *firm-age* as the strongest rival explanator upon *competitive strategy*. I always used a stepwise method ('Forward Entry'). Interestingly, the results agree in that the respective financial indicator is retained as significant, and mostly as stronger determinant of competitive strategy than firm-age. The only exception to this rule is constituted by the three analyses on other non-current liabilities: The latter do not even qualify as a statistically *insignificant* determinant of competitive strategy, leaving firm-age as the only predictor of competitive strategy. This, in turn, confirms the observation made on the basis of table 2.2.: other non-current liabilities do not constitute a necessary source of finance for any of the three competitive strategies.

literature does not propose any hypothesis about the impact of other non-current liabilities on competitive strategy. The reason, simply, is that this type of finance is not provided by external financiers; it is an internally generated source of finance. Consequently, the exclusion of other non-current liabilities from the following analyses did not hinder the assessment of the hypotheses elaborated in section 2.2..

The second technical remark I wish to make also concerns the fact that the five financial indicators add up to 100% of a firm's capital. As a result, they co-vary to the extent that an increase in one financial indicator necessarily entails a relative decrease in the other indicators, and vice-versa. To determine the individual explanatory power of each type of finance, it is most instructive to use a 'stepwise forward' regression-method. I therefore employed the 'Forward (LR)' method in all the following binary logistic regressions, whereas I used the 'Forward Entry' method for all multi-nominal logistic analyses (see Field 2000: 168-170).

Thirdly, it is possible that one type of finance *alone* has no significant impact on competitive strategy, but in combination with another source of finance qualifies as an important predictor. For example, long-term debt on its own may not further the pursuit of a DQP strategy, but in combination with short-term liabilities does. To test the impact of financial combinations on competitive strategy, I created six financial interaction terms[47]. I added these six interaction terms in a second step to all the binary logistic regression analyses in section 2.3.3.1.. That said, let us finally turn to assess whether specific sources of finance facilitate the pursuit of specific competitive strategies.

2.3.3.1. How Firms finance RPI, DQP, and LCP Strategies: Comparing Each Strategy with the Two Others

If the hypotheses of the competitiveness literature hold true, we should find that Radical Product Innovators finance their activities mostly from share capital (Vitols 2001: 350; 359-360; Hall and Soskice 2001a: 40; CPB Netherlands 1997: 354-355; see CPB Netherlands 1997: 146-147; 162; Ohlin 1933: 7; 55), whereas Low Cost Producers use long-term debt (see Vitols 2001: 352; CPB Netherlands 1997: 353-354). Diversified Quality Producers, in turn, should make great use of both share capital and long-term debt in order to finance their activities (Vitols 2001: 350; 352; 359-360; Hall and Soskice 2001a: 27; 39-41; CPB Netherlands 1997: 353-354; 355-356; Hollingsworth 2000: 628; see Lindgaard Christensen 1992: 146-147; 162; Ohlin 1933: 7; 55). To test these hypotheses, I proceeded in two steps. In the present section (section 2.3.3.1.), I present

[47] These six interaction terms constitute all logically possible combinations of the four finance indicators: (1) share capital * retained earnings, (2) share capital * long-term debt, (3) share capital * short-term liabilities, (4) retained earnings * long-term debt, (5) retained earnings * short-term liabilities, (6) long-term debt * short-term liabilities.

binary logistic regression analyses which reveal the extent to which each strategy relies on specific financial means in comparison to the *two other strategies* ***combined.*** In section 2.3.3.2., I carried out ***multi-nominal*** *logistic regression analyses* in order to assess the impact of finance by comparing each strategy to the *two other strategies* ***separately.***

Let us begin by testing the hypotheses of the competitiveness literature on the basis of binary logistic regression analyses. In essence, I carried out two regressions for each competitive strategy. The first analysis assessed the impact of *share capital*, *retained earnings*, *long-term debt*, and *short-term liabilities* (independent variables) on the *respective competitive strategies*, i.e. first on *RPI*[48], then on *DQP*[49], and finally on *LCP*[50] (dependent variable). The second analysis tested the relative importance of the competitiveness literature's hypotheses and the argument of the innovation literature on firm-age. It therefore correlated *share capital*, *retained earnings*, *long-term debt*, *short-term liabilities*, **and *firm-age*** (independent variables) with the *respective competitive strategies*, i.e. first with *RPI*, then with *DQP*, and finally with *LCP* (dependent variable). In addition, I wanted to assess whether country-specific variations exist in the extent to which each competitive strategy relies on a specific means of finance. To this end, I repeated the two aforementioned analyses for each country separately.[51]

Table 2.3.: Impact of Finance and Firm-Age on Radical Product Innovation (Results of Binary Logistic Regression Analyses: Unstandardised B)

	Analysis 1 (ShCap, RetEar, LtDebt, StLiab → RPI)	**Analysis 2** (ShCap, RetEar, LtDebt, StLiab, Age → RPI)
Constant	2.726***	2.726***
ShCap RetEar	3.699*** 11.658***	3.699*** 11.658***
LtDebt StLiab Age		
N	74	74
Cox & Snell R² Nagelkerke R²	.555 .684	.555 .684

significance levels: * < 0.10 ** < 0.05 *** < 0.01

[48] I obtained the *RPI variable* from assigning a score of 1 to all firms which pursue an RPI strategy, whereas I attributed a score of 0 to all firms that pursue a DQP or an LCP strategy.
[49] I obtained the *DQP variable* from assigning a score of 1 to all firms that pursue a DQP strategy, whereas I attributed a score of 0 to all firms which pursue an RPI or an LCP strategy.
[50] I obtained the *LCP variable* from assigning a score of 1 to all firms which pursue an LCP strategy, whereas I attributed a score of 0 to all firms that pursue an RPI or a DQP strategy.
[51] As mentioned in the introduction to section 2.3.3., all 6 financial interaction effects were added in a second model to each regression analysis.

Table 2.3. reports the results of the two analyses of Radical Product Innovation. Since country-specific variations cannot be observed, the results obtained for the overall firm sample are reported. Interestingly, table 2.3. confirms the competitiveness-literature hypothesis that Radical Product Innovation is facilitated by *share capital* (Vitols 2001: 350; 359-360; Hall and Soskice 2001a: 40; CPB Netherlands 1997: 354-355; see CPB Netherlands 1997: 146-147; 162; Ohlin 1933: 7; 55): Radical Product Innovators rely on this financial means significantly more than Diversified Quality Producers and Low Cost Producers. Accordingly, step 1 of both regression analyses reveals that share capital is the best predictor of an RPI strategy. Interestingly, though, step 2 of both analyses disproves the idea of the competitiveness literature that *debt finance* hampers the pursuit of an RPI strategy, but furthers DQP and LCP (see Vitols 2001: 352; CPB Netherlands 1997: 353-354; Hollingsworth 2000: 628). On the contrary, firms pursuing an RPI strategy rely on long-term debt significantly more than firms pursuing a DQP or an LCP strategy. Furthermore, long-term debt exerts a fairly strong influence on RPI because the explanatory power of the step1-model (R^2 = .555) increases by 12.9% when long-term debt is included as a second predictor of RPI in step2 (R^2 = .684). In sum, the competitiveness literature seems *right* in suggesting that share capital facilitates Radical Product Innovation, whereas it seems *mistaken* in perceiving long-term debt as a stumbling block to the pursuit of an RPI strategy.[52]

Furthermore, it is interesting to note that the results obtained are stable in two respects: on the one hand, the results of analysis 1 remain unchanged when firm-age is introduced in analysis 2 as an additional explanatory variable. The outcome of analysis 2 is therefore identical to the outcome of analysis 1. On the other hand, the results are also stable to the extent that country-specific variations cannot be observed. While the overall number of cases is sometimes too narrow to provide significant results at a .10 significance level, share capital and long-term debt always emerge as the strongest predictors of RPI. In none of the country-specific analysis is firm-age retained as an explanator of an RPI strategy – not even as a statistically insignificant explanator.

Finally, I want to draw attention to the finding that both share capital and long-term debt constitute better predictors of RPI than firm-age. This finding can be interpreted to the effect that the arguments of the competitiveness literature provide a better explanation of Radical Product Innovation than the arguments of Abernathy and Utterback (1994). In other words, specific types of finance can be said to constitute necessary, and more important input factors for the pursuit of

[52] It should also be noted that none of the financial interaction effects, which I added to each regression analysis in a second model, exerts a significant influence on RPI.

an RPI strategy than young firm-age. Having revealed share capital and long-term debt to be crucial for Radical Product Innovation, let us study whether Diversified Quality Production is also facilitated by specific types of finance.

Table 2.4.: Impact of Finance and Firm-Age on Diversified Quality Production (Results of Binary Logistic Regression Analyses: Unstandardised B)

Independent variables, retained in each step	**Analysis 1** (ShCap., RetEar, LtDebt, StLiab → DQP)	**Independent variables, retained in each step**	**Analysis 2** (ShCap., RetEar, LtDebt, StLiab, Age→DQP)
Step 1: Retained Earnings	1.768***	Step 1: Firm-Age	.024***
Step 2: -	-	Step 2: Retained Earnings Firm-Age	1.347** .017**
Step 3: -	-	Step 3: Shareholder-Cap. Retained Earnings Firm-Age	2.640** 3.961*** .022***
N	74	N	74
R^2 Nagelkerke Step 1 Step 2 Step 3	.234 - -	R^2 Nagelkerke Step 1 Step 2 Step 3	.248 .344 .406
Significance levels: * ≤ 0.10 ** ≤ 0.05 *** ≤ 0.01			

Table 2.4. reports the outcome of the two binary logistic analyses of Diversified Quality Production. As with Radical Product Innovation, noteworthy country-specific deviations from the overall results cannot be observed. Therefore, table 2.4. reproduces the outcome which I obtained from analysing the overall sample. In line with our previous findings on RPI, table 2.4. does not provide empirical support for the hypothesis that *long-term debt* constitutes an important source of finance for the pursuit of a DQP strategy (see Vitols 2001: 352; CPB Netherlands 1997: 353-354; Hollingsworth 2000: 628). In neither the first nor the second analysis does long-term debt qualify as a predictor of DQP. Since Diversified Quality Producers do not make significant use of long-term debt to finance their activities, debt finance does not seem to facilitate the pursuit of this strategy.[53]

While the competitiveness-literature hypothesis on the facilitative impact of long-term debt lacks empirical support, the above results support the hypothesis on *share capital* (Vitols 2001: 350; 359-360; Hall and Soskice 2001a: 27; 39-41; CPB Netherlands 1997: 355-356; see

[3] It should also be noted that none of the interaction terms, which I added to each analysis in a second model, qualifies as a predictor of DQP.

Lindgaard Christensen 1992: 146-147; 162; Ohlin 1933: 7; 55). The outcome of analysis 2 (step 3) suggests that share capital is an important financial source for DQP. However, the results of both analysis 1 and analysis 2 also show that *retained earnings* constitute an even more important means of finance. Accordingly, retained earnings qualify as the strongest predictor of DQP in analysis 1. Similarly, analysis 2 shows that Diversified Quality Producers resort to retained earnings more than any other source of finance. Yet, analysis 2 also reveals that, as soon as firm-age is included as an independent variable, it is a stronger predictor of Diversified Quality Production than any financial means. Does this finding indicate that a firm needs to have reached a certain age rather than acquired specific financial means in order to be able to pursue a DQP strategy?

To make sense of the findings on Diversified Quality Production, it is important to note that the outcome of analysis 1 is much more stable than the outcome of analysis 2: no other source of finance qualifies as a predictor of DQP in the second step of analysis1. Furthermore, all country-specific analyses – regressing the four financial variables on DQP – keep *retained earnings* as the only significant explanator of Diversified Quality Production. As soon as firm-age is included as an additional independent variable, country-specific analyses produce differing outcomes. That is, the Italian analysis continues to identify *retained earnings* as the only and strongly significant predictor of DQP, whereas the British analysis retains firm-age as the only but less significant determinant. The German analysis, in contrast, does not identify any independent variable strong enough to qualify as an explanator of DQP.

Bearing this in mind, it is useful to recall the second observation we made on the basis of table 2.2. (section 2.3.1.). Country-specific accounting rules blur the overall picture of DQP in that the comparatively high amount of other non-current liabilities used by German DQPs takes up the explanatory power of the other financial indicators. In addition to this, not only retained earnings but also share capital constitutes an important source of finance for Diversified Quality Production (see step 3 of analysis 2). These two financial variables further deprive each other of their respective explanatory power. Overall, this has two consequences: on the one hand, firm-age emerges as the strongest determinant of DQP in analysis 2. On the other hand, the results of analysis 2 are less stable than the results of analysis 1.

In sum, the results on the DQP strategy are best summarised as follows: While table 2.4. indicates that Diversified Quality Production requires specific types of finance (namely *retained earnings* and *share capital*), additional analyses need to be carried out in order to understand whether a mature firm-age constitutes an even more important factor. Having found the competitiveness literature right in suggesting that *share capital* facilitates the pursuit of a DQP

strategy but wrong in assuming that *debt finance* has a facilitative impact, let us turn to the analyses of Low Cost Production. Does empirical evidence support the hypotheses that an LCP strategy is facilitated by a comparatively high amount of debt finance (see Vitols 2001: 352; CPB Netherlands 1997: 353-354), and by a limited use of share capital (see Bronk 1998: 14; Hall and Soskice 2001a: 39; Mayer 1998: 159-160; CPB Netherlands 1997: 348)?

Table 2.5.: Impact of Finance and Firm-Age on Low Cost Production (Results of Binary Logistic Regression Analyses: Unstandardised B)

Independent variables, retained in each step	**Analysis 1** (ShCap., RetEar, LtDebt, StLiab → LCP)	**Analysis 2** (ShCap., RetEar, LtDebt, StLiab, Age →LCP)
Step 1: Short-term Liabilities	4.618 ***	4.618 ***
Step 2: Share capital Short-term Liabilities	-19.644 *** 1.561	-19.644 *** 1.561
Step 3: Share capital	-21.762 ***	-21.762 ***
N	74	74
R^2 Nagelkerke Step 1: Step 2: Step 3:	.247 .541 .528	.247 .541 .528
Significance levels: * < 0.10 ** < 0.05 *** < 0.01		

Table 2.5. provides various insights into how finance impacts on Low Cost Production. In so doing, the table presents the outcome obtained from the analysis of the entire firm sample, as noteworthy country-specific deviations from these results were not observed. In line with the analyses on RPI and DQP, table 2.5. refutes the competitiveness-literature hypothesis that *debt finance* furthers LCP (see Vitols 2001: 352; CPB Netherlands 1997: 353-354). In neither analysis1 nor analysis 2 does long-term debt qualify as a predictor of Low Cost Production. In other words, Low Cost Producers do not incur debt any more than Radical Product Innovators and Diversified Quality Producers in order to finance their activities. This finding can be interpreted to the effect that debts do not constitute a necessary input factor for the pursuit of an LCP strategy.

While empirical evidence contradicts the competitiveness-literature hypothesis on debt finance, table 2.5. provides empirical support for the argument that *share capital* hampers Low Cost Production (see Bronk 1998: 14; Hall and Soskice 2001a: 39; Mayer 1998: 159-160; CPB Netherlands 1997: 348). Accordingly, steps 2 and 3 of both analyses illustrate that Low Cost

Producers use significantly less share capital than Radical Product Innovators and Diversified Quality Producers. The reduced use of share capital by Low Cost Producers is so pronounced that this type of finance even qualifies as the sole predictor of an LCP strategy in step 3 of both analyses.

Considering that firms do not finance Low Cost Production from debt or share capital, to which financial means do they resort? Table 2.5. allows us to answer this question unambiguously: *short-term liabilities* constitute the most important source of finance for Low Cost Production. Accordingly, short-term liabilities are retained as the most significant means of finance in step 1 of both analyses[54]. Interestingly, Low Cost Producers rely on short-term liabilities and abstain from using share capital to the extent that results do not change if firm-age is added as a rival explanator. Consequently, the outcome of analysis 2 is identical to the outcome of analysis 1. This, in turn, indicates that a firm's competitive strategy can be predicted more accurately by the financial means employed than by its age. We can therefore deduce that the argument of Abernathy and Utterback on the importance of firm-age (see Utterback 1994: 90-101; 160-165) is a worse explanation for competitive strategy than the arguments of the competitiveness literature on financial input factors (see Bronk 1998: 14; Hall and Soskice 2001a: 39; Mayer 1998: 159-160; CPB Netherlands 1997: 348).

Let us conclude the comments on these analyses with the following summary. Overall, the section has shown that Radical Product Innovators finance their activities mostly from share capital and to a lesser extent from debt. Diversified Quality Producers, in turn, tend to use retained earnings and some share capital. Low Cost Producers, on the other hand, refuse to finance their activities from share capital relying substantially on short-term liabilities. These findings confirm the hypotheses of the competitiveness literature regarding the importance of share capital for RPI on the one hand, and DQP on the other (Vitols 2001: 350; 359-360; Hall and Soskice 2001a: 27; 39-41; CPB Netherlands 1997: 354-356; see Lindgaard Christensen 1992: 146-147; 162; Heckscher 1919: 7; 55). Yet they also fail to support the hypothesis that debt finance constitutes an important input factor for Diversified Quality Production and Low Cost Production alike (see Vitols 2001: 352; CPB Netherlands 1997: 353-354; Hollingsworth 2000: 628). On the contrary, I found that only Radical Product Innovators use this type of finance. Finally, we have seen that specific financial means often, but not always, constitute a more important input factor for the pursuit of a specific strategy than a firm's age. In order to cross-check the findings on finance, and to assess the respective importance of finance and firm-age for

[54] It should also be noted that none of the interaction terms, added to each analysis in a second model, qualifies as a predictor of Low Cost Production.

the pursuit of a specific strategy, it is useful to carry out multi-nominal logistic regression analyses. Section 2.3.3.2. presents their results.

2.3.3.2. How Firms finance RPI, DQP, and LCP Strategies: Comparing Each Strategy Separately

Let us recall that the findings of section 2.3.3.1. were obtained from *binary* logistic regression analyses which compare all firms that pursue the same strategy to all firms that do not pursue this strategy. However, it may be possible that the strategy in question is facilitated by a factor which has an opposite effect on the two other strategies. This factor may not qualify as a predictor because its impact is neutralised by the fact that the two other strategies are grouped in the same category. For example, Diversified Quality Producers and Low Cost Producers may rely on a high amount of retained earnings, whereas Radical Product Innovators may not. Hence, retained earnings may not qualify as a predictor of LCP because the RPI- and the DQP-cases combined neutralise the explanatory power of retained earnings. Similarly, the explanatory power of firm-age may be neutralised because two strategies on which firm-age exerts the opposite effect are grouped in the same category.

It is therefore useful to determine the impact of the respective independent variables on each strategy *individually*. To this end, multi-nominal regression analyses are most suited. Overall, I carried out 6 regression analyses. In the first 5 regressions, I correlated each of the *four financial variables* and *firm-age* alone with *competitive strategy* in order to assess the *individual* explanatory power of each indicator. In the sixth analysis, I assessed the *relative* explanatory power of the five indicators by correlating them together with competitive strategy. Each of these 6 regression analyses contains 3 models, as the first model uses RPI, the second model DQP, and the third model LCP as reference category.

Table 2.6.: Individual and Joint Impact of Finance & Firm-Age on Competitive Strategy Results of Multi-Nominal Logistic Regression Analyses (Standardised B)

Independent Variable:	Model 1: Ref. Category: RPI		Model 2: Ref. Category: DQP		Model 3: Ref. Category: LCP	
	DQP	LCP	RPI	LCP	RPI	DQP
1. S.holder Capital Exp (B)	-2.308 ***	-23.680 ***	2.308 ***	-21.372 ***	23.680 ***	21.372 ***
$R^2_{Nagelkerke}$	.619					
2. Ret. Earnings Exp (B)	3.601 ***	4.091 ***	-3.601 ***	.490	-4.091 ***	-.490
$R^2_{Nagelkerke}$	.461					
3. L.term Debt Exp (B)	-5.601 **	-5.959 *	5.601 **	-.358	5.959 *	.358
$R^2_{Nagelkerke}$	.105					
4. S.term Liabilities Exp (B)	2.018	5.956 ***	-2.018	3.938 ***	-5.956 ***	-3.938 ***
$R^2_{Nagelkerke}$	.211					
5. Firm-Age Exp (B)	.043 ***	.029 **	-.043 ***	-.014 *	-.029 **	.014 *
$R^2_{Nagelkerke}$	.277					
6.1. S.holder Capital Exp (B) Step 1	-2.308 ***	-23.680 ***	2.308 ***	-21.372 ***	23.680 ***	21.372 ***
Step 2	-3.396 ***	-26.028 ***	3.396 ***	-22.632 ***	26.028 ***	22.632 ***
$R^2_{Nagelkerke}$ Step 1	.619					
Step 2	.697					
6.2. L.term Debt Exp (B) Step 2	-13.119 ***	-8.502 *	13.119 ***	4.617	8.502 *	-4.617
$R^2_{Nagelkerke}$ Step 2	.697					

Significance levels: * < 0.10 ** < 0.05 * < 0.01**

Table 2.6. provides an overview of the outcomes of the various analyses. What do these results teach us? To begin with, it is particularly interesting that the three competitive strategies differ most notably from each other in how far they rely on financial means provided by *external investors*. Analysis 6 identifies *share capital* and *long-term debt* as the most important determinants of competitive strategy. Neither *retained earnings* nor *short-term liabilities* are retained in analysis 6, because competitive strategies do not vary significantly enough in how far they rely on these internally generated means of finance. This finding can be interpreted in favour of the competitiveness literature's argument that the input factors decisive for a competitive strategy's success cannot be provided by a firm on its own, but only following the solution of a coordination problem with external economic actors (see in particular Hall and Soskice 2001a: 6-7; see also Lundvall 1992a: 13-15; Andersen 1992: 68-69; Patel and Pavitt 1994: 91-92; Hollingsworth 2000: 627-628; 632; Porter 1990: 20).

Table 2.6. provides empirical support for the hypotheses of the competitiveness literature that *share capital* facilitates the pursuit of both an RPI and a DQP strategy (Vitols 2001: 350; 359-360; Hall and Soskice 2001a: 27; 39-41; CPB Netherlands 1997: 354-356; see Lindgaard Christensen 1992: 146-147; 162; Ohlin 1933: 7; 55), while hampering the pursuit of an LCP strategy (see Bronk 1998: 14; Hall and Soskice 2001a: 39; Mayer 1998: 159-160; CPB Netherlands 1997: 348). More precisely, a linear correlation exists between the technology intensity of a competitive strategy and the amount of share capital employed (see analysis 1 and 6.1.): While Radical Product Innovators use a particularly high amount of this financial resource, Diversified Quality Producers rely on a significant but more limited amount of share capital. Low Cost Producers, in turn, do not finance their activities from this source of finance.

Contrary to the hypothesis on share capital, empirical evidence does not support the hypothesis of the competitiveness literature on *debt finance*. While empirical evidence shows long-term debt to be an important means of finance (see analysis 6.2. and analysis 3.), it is not true that Diversified Quality Producers and Low Cost Producers incur more debts than Radical Product Innovators. On the contrary, the opposite can be observed: firms which pursue an RPI strategy are significantly more in debt than DQPs and LCPs alike. From this we can deduce that the competitiveness literature wrongly suggests debt finance to facilitate the pursuit of a DQP and an LCP strategy (see Vitols 2001: 352; CPB Netherlands 1997: 353-354; Hollingsworth 2000: 628).

Let us furthermore recall our findings from the previous binary regressions on Diversified Quality Production and Low Cost Production. These analyses showed *retained earnings* to be an important means of finance for DQP, and *short-term liabilities* to be a significant financial resource for LCP. Yet neither retained earnings nor short-term liabilities qualify as predictors of competitive strategy in analysis 6 under the present multi-nominal regressions. How can we make sense of this?

In essence, the reason for which neither retained earnings nor short-term liabilities are retained in analysis 6 is that the three strategies do not vary significantly enough in the extent to which they use these two financial means. While it is true that Diversified Quality Producers use significantly more retained earnings than Radical Product Innovators, Low Cost Producers also rely on this financial resource significantly more than Radical Product Innovators (see analysis 2: model 1). In other words, both DQPs and LCPs finance their activities from retained earnings to roughly the same extent (see analysis 2: model 2 and 3). The same holds true for short-term liabilities. While Low Cost Producers employ significantly more short-term liabilities than Radical Product Innovators and Diversified Quality Producers (see analysis 4: model 3), the latter

two use this financial resource to a similar extent (see analysis 4: model 1 and 2). It therefore depends on the type of analysis whether retained earnings and short-term liabilities qualify as significant financial instruments.

These insights allow us to draw the following conclusion: While retained earnings constitute an important means of finance for a DQP strategy, as do short-term liabilities for an LCP strategy, the extent to which firms rely on share capital and long-term debt has a more significant impact on the respective competitive strategies. Hence, contrary to internally generated finance (namely *retained earnings* and *short-term liabilities*), finance provided by external financiers (i.e. *share capital* and *debt finance*) decisively facilitates a firm's competitive strategy.

This conclusion also holds true for the impact of firm-age on competitive strategy: Model 1 of analysis 5 shows that Radical Product Innovators are significantly younger than Diversified Quality Producers and Low Cost Producers, whereas DQPs are older than LCPs (see analysis 5: model 3). However, these differences are not pronounced enough for firm-age to qualify as a predictor of competitive strategy in analysis 6. Therefore, share capital and long-term debt have a more decisive impact on competitive strategy than a firm's age. Consequently, we can deduce that – rather than a firm's age – externally provided means of finance decisively facilitate the pursuit of specific competitive strategies. Thus, the arguments of the competitiveness literature (Vitols 2001: 350; 359-360; Hall and Soskice 2001a: 27; 39-41; CPB Netherlands 1997: 354-356; see Bronk 1998: 14; Mayer 1998: 159-160; CPB Netherlands 1997: 348; Lindgaard Christensen 1992: 146-147; 162; Ohlin 1933: 7; 55) provide a better explanation of competitive strategy than the argument of Abernathy and Utterback (see Utterback 1994: 90-101; 160-165).

2.4. Testing the Hypotheses on Share capital: Do Specific Strategies require Specific Types of Share capital?

Section 2.3. has essentially shown three things. Firstly, we found the competitiveness literature right in suggesting that finances provided by external investors are of decisive importance for the pursuit of specific competitive strategies. Neither a *firm's age*, constituting the strongest rival explanation for a firm's strategy, nor internally generated financial means have an equally facilitative impact on competitive strategy as *share capital* and *debt finance*. That said, we found, secondly, the competitiveness literature wrong in suggesting that Diversified Quality Producers and Low Cost Producers rely on debt finance, while Radical Product Innovators have difficulties in obtaining such financial means because creditors are risk-averse (see Vitols 2001: 352; CPB Netherlands 1997: 353-354; Hollingsworth 2000: 628). On the contrary, we discovered

that firms pursuing an RPI strategy incur significant debts, whereas firms pursuing a DQP or an LCP strategy abstain from doing so.

The latter finding suggests that the competitiveness literature overestimates the extent to which creditors make their investment decisions dependent upon a firm's strategy. It cannot be denied that creditors are risk-averse. However, mainstream finance theory teaches us that creditors decide on the basis of a variety of grounds whether to invest in a company or not. While a firm's strategy may play a role in the assessment of its credit-worthiness, creditors are more interested in available securities which would become their property if the firm goes bankrupt (Schneck 1998: 438; 436-437). Hence, as long as firms possess securities, they will be granted a loan – irrespective of the competitive strategy they pursue. Since Radical Product Innovators are often young (start-up) companies (see section 2.3.2.2.), they have comparatively high funding requirements without the possibility of relying on internally generated means of finance. It is therefore rather unsurprising that firms pursuing an RPI strategy go into debt more substantially than firms pursuing a DQP or an LCP strategy.

Thirdly, contrary to their propositions on debt finance, we found proponents of the competitiveness literature right in suggesting that share capital facilitates both an RPI and a DQP strategy, whereas it hampers Low Cost Production (Vitols 2001: 350; 359-360; Hall and Soskice 2001a: 27; 39-41; CPB Netherlands 1997: 354-356; see Bronk 1998: 14; Mayer 1998: 159-160; CPB Netherlands 1997: 348; Lindgaard Christensen 1992: 146-147; 162; Ohlin 1933: 7; 55). Accordingly, we saw that Radical Product Innovators and Diversified Quality Producers use substantially more share capital than Low Cost Producers. Let us, however, remind ourselves that these findings are only preliminary requirements in order to assess the central claim of the competitiveness literature. Essentially, the literature does *not* argue that both an RPI and a DQP strategy are facilitated by share capital *per se*, but that each strategy is facilitated by a *different type* of share capital. While *outsider* share capital is said to further RPI, *insider* share capital is held to promote DQP (Vitols 2001: 350; 359-360; Hall and Soskice 2001a: 27; 39-41; CPB Netherlands 1997: 354-356; see Lindgaard Christensen 1992: 146-147; 162; Ohlin 1933: 7; 55). This claim, in turn, is the basis of the competitiveness literature's argument that firms in insider corporate-governance systems specialise in the pursuit of DQP, whereas firms in outsider corporate-governance systems engage instead in RPI (Hall and Soskice 2001a: 39-40; Vitols 2001: 350-352; Bronk 1998: 15; CPB Netherlands 1997: 355-356; Mayer 1998: 159-160; 162; Ohlin 1933: 7; 55; Lindgaard Christensen 1992: 146-147; 162; Hollingsworth 2000: 628).

It is the aim this section to test the hypothesis on specific types of share capital in order to understand whether national corporate-governance institutions actually have an impact on a

firm's competitive strategy. In so doing, section 2.4.1. finds the competitiveness literature wrong in hypothesising that insider share capital facilitates Diversified Quality Production, while outsider shareholder finance presumably promotes Radical Production Innovation. Yet section 2.4.2. provides an alternative explanation as I show that an RPI strategy is facilitated by *institutional* share capital, whereas DQP is promoted by *private* shareholder funds. Importantly, this finding does not only explain how firms in the same economy can pursue the same variety of competitive strategies. Section 2.4.3. illustrates that this finding also allows us to understand how entrepreneurs secure institutional share capital in institutionally suboptimal economies.

2.4.1. Falsifying the Hypothesis on the Importance of Insider and Outsider Share Capital

Let us briefly recall the reasoning of the competitiveness literature (see also section 2.2.). In essence, specific types of share capital are said to promote specific strategies depending on the control rights of shareholders in insider and outsider corporate-governance systems respectively. Since shareholders in outsider systems can only monitor the performance of their investment via publicly available accounting indicators, they are said to exit a firm as soon as its shareholder value declines. Accordingly, managers in outsider systems have to focus on the maximisation of shareholder profits. They are therefore said to pursue a high-risk, high-return RPI strategy because the latter potentially provides the highest shareholder value (CPB Netherlands 1997: 346; 348-350; Vitols 2001: 350-352). The opposite holds true for shareholders in insider systems, who are granted an important say in how their funds are used (CPB Netherlands 1997: 350-351). Since shareholders understand whether a decline in their shares' value results from mismanagement, or from investment in projects that will become profitable in the future, they are assumed to prefer a DQP strategy. Although the latter potentially provides lower returns, these returns are more certain to materialise because incremental innovation is comparatively less risky (CPB Netherlands 1997: 353-354; Vitols 2001: 350-352). It is interesting to note that this reasoning tacitly assumes shareholders in outsider systems to have other risk-return preferences than shareholders in insider systems. That is, outsider shareholders are assumed to prefer high-return, high-risk strategies, whereas the opposite holds true for insider shareholders. I will elaborate on this argument in section 2.4.2..

So, is it true that outsider share capital facilitates the pursuit of an RPI strategy, whilst insider shareholder finance promotes DQP? To answer this question, it has to be stressed that the control rights of shareholders are usually determined by national legislation. In most Western economies, corporate-governance systems are therefore homogenous throughout the country. Both Germany and the UK are examples of this 'one country, one type of corporate governance'-

rule. On the one hand, Germany is an ideal-typical example of the insider corporate-governance system as shareholders of joint-stock companies (taking the form of an *AG* or a *GmbH*) enjoy considerable consultation and participation rights (CPB Netherlands 1997: 357-359; Vitols 2001: 337-345; Bronk 1998: 11-12). On the other hand, the UK provides an ideal-typical example of an outsider corporate-governance system as all shareholders of a joint-stock company (taking the form of a *Plc.* or a *Ltd.*) have limited consultation rights (Vitols 2001: 337-345; Bronk 1998: 5-7).

Interestingly, Italy constitutes an exception to this rule of 'one country, one system of corporate governance'. Until June 2003, Italian corporate-governance regulation also foresaw just one system of corporate control for joint-stock companies. This traditional system – also referred to as *sistema dualistico orizzontale* (Fiori, Tiscini, and Di Donato 2004: 60) – is similar to an insider system in that shareholders do not only elect the firm's management, i.e. the Board of Directors (*Consiglio di Amministrazione*). They also elect a Board of Auditors (*Collegio Sindacale*) which has to ensure that the company's management complies with the law, the articles of association, and the principles of good administration and management. Furthermore, the Board of Auditors controls the adequacy of all corporate financial issues (De Vecchi and Roussey 2003: 8). However, unlike the Supervisory Board (*Aufsichtsrat*) of Germany's insider system, the Italian Board of Auditors (*Collegio Sindacale*) does not oversee the *efficiency* of managerial decisions. It merely controls the *legitimacy* of the management's actions (Fiori et al. 2004: 56). That said, shareholders of Italian joint-stock companies often enjoy *de facto* important participation rights because they typically hold a large part of shares. As a result, these block shareholders are often members of the firm's Board of Directors, or entertain very close relationships with the firm's management (Aguilera 1998: 77-82; see also Fiori et al. 2004: 56). Interestingly, this is also true for almost all Italian firms included in the case sample (see introduction to section 2.3.). Hence, the traditional Italian corporate-governance system *de lege* and *de facto* grants insider control rights to shareholders.

The Italian system of corporate governance was recently reformed by legislative decree No. 6 of 17th January 2003 (*decreto legislative 6/2003*). Most importantly, the decree ended Italy's single corporate-governance system, as it added two new systems: namely an insider-control system (also referred to as *sistema dualistico verticale*), and an outsider-control system (also termed *sistema monistico*). Interestingly, these two systems are an *explicit* imitation of the German system of insider governance on the one hand, and the Anglo-Saxon system of outsider governance on the other (De Vecchi and Roussey 2003: 4; Fiori et al. 2004: 60). Consequently, Italian firms now have the choice between three different models of corporate governance.

Despite this choice, they have so far been rather hesitant to change their models of corporate control. Accordingly, the vast majority of Italian firms, and all Italian companies included in the case sample, continue to operate under the traditional system which, as described above, grants insider control rights to shareholders (see Fiori et al. 2004: 61-68).

That said, let us return to the initial question of whether insider share capital promotes a DQP strategy, while outsider share capital facilitates the pursuit of RPI. We can now answer this question, without resorting to quantitative analyses, as this hypothesis obviously lacks empirical support. Let us recapitulate that shareholders in German and Italian joint-stock companies provide insider capital, whilst their counterparts in British joint-stock companies deliver outsider capital. Consequently, the hypothesis of the competitiveness literature would be confirmed if those German and Italian firms, which substantially finance their activities from share capital, pursued a DQP strategy. Similarly, British firms, using shareholder funds as an important means of finance, should specialise in the pursuit of an RPI strategy. Our case sample clearly shows that this is not true. British, German, and Italian companies financing their activities mostly from share capital pursue an RPI and a DQP strategy alike. Similarly, no empirical evidence exists to suggest that Italian firms have adopted that model of corporate governance which the competitiveness literature perceives as most conducive to their strategy. Instead, companies in Italy continue to use the traditional corporate governance system, irrespective of the strategy they pursue. Thus, empirical evidence contradicts the hypothesis of the competitiveness literature that insider share capital facilitates Diversified Quality Production, wheareas outsider shareholder funds promotes Radical Product Innovation (Vitols 2001: 350; 359-360; Hall and Soskice 2001a: 27; 39-41; CPB Netherlands 1997: 354-356; see Lindgaard Christensen 1992: 146-147; 162; Ohlin 1933: 7; 55).

2.4.2. Verifying the Hypothesis on the Importance of Institutional and Private Share Capital

While empirical evidence does not support the literature's hypothesis on insider and outsider share capital (see section 2.4.1.), the shareholder structure of Italian firms suggests an alternative hypothesis on how specific types of share capital might facilitate specific competitive strategies. Interestingly, most shareholders in Italian firms included in the sample are block shareholders, with substantial insight into how the company is run. Nevertheless, one striking difference seems to exist between shareholders in Diversified Quality Producers on the one hand, and Radical Product Innovators on the other. Block shareholders in Diversified Quality Producers are often members of the founding family, i.e. *private* investors. Block shareholders of Radical Product Innovators, by contrast, tend to be *institutional* investors, i.e. venture capitalists, other

firms, or investment funds. Thus, it seems that a comparatively large amount of *institutional* share capital facilitates the pursuit of an *RPI strategy*, whereas a high amount of *private* shareholder finance is conducive to a *DQP strategy*.

Before asking about the reasons for this, let us find out whether empirical evidence supports this hypothesis. To test whether *institutional* share capital facilitates Radical Product Innovation, while *private* shareholder funds promote Diversified Quality Production, I divided the overall share capital of RPIs and DQPs into their institutional and private components. In so doing, I counted all shares held by venture-capitalist firms, business angels[55], companies, banks, and investment funds as *institutional share capital*. On the other hand, I considered all shares held by the firm's founders, managers, employees, and private investors to be the firm's *private share capital*. Overall, I obtained data for 40 cases. Table 2.9. provides an overview of the extent to which institutional and private investors hold shares in firms pursuing an RPI strategy on the one hand, and a DQP strategy on the other.

Table 2.7.: Ownership Structure of RPIs and DQPs
(Percentage of Institutional and Private Share capital; per Country and Overall)

Shareholder Capital	UK (N = 12)		Germany (N = 17)		Italy (N = 11)		All 3 Countries (N = 40)	
	Inst.	Private	Inst.	Private	Inst.	Private	Inst.	Private
Ø RPIs	83 %	17 %	61 %	39 %	67 %	33 %	70 %	30 %
Ø DQPs	69 %	31 %	43 %	57 %	15 %	85 %	41 %	59 %
Overall Ø	77 %	23 %	51 %	49 %	39 %	61 %	56 %	44 %

Interestingly, the empirical evidence presented in table 2.7. confirms the idea that institutional shareholders invest in Radical Product Innovators, whilst private shareholders prefer investing in Diversified Quality Producers. If we look at the average results for all three countries, we find that institutional investors hold 70% of shares in radically innovative firms, but only 41% in incrementally innovative companies. The opposite relationship can be observed for private investors who hold 30% of shares in RPIs, but 59% in DQPs. Regarding the overall average of all three countries, we see that the extent of institutional (56%) and private (44%)

[55] While business angels are mostly private investors, I count them here as institutional shareholders because they presumably have the same risk-return preferences as institutional investors (see below). The reason for this is that business angels have substantial knowledge about investment projects in a given industry in general, and about the specific firms in this industry in particular.

shareholdings is roughly the same.[56] That said, it is interesting that the overall distribution of institutional and private shareholdings varies from one country to another. British firms hold 77%, German companies 51%, and Italian firms only 39% of institutional share capital. Of course, the opposite applies to private shareholdings which amount to 23% in British, 49% in German, and as much as 61% in Italian firms. As I will argue in section 2.4.3., these country-specific variations reflect the extent to which private pension and insurance systems promote the emergence of institutional shareholders. That said, it is striking that *Radical Product Innovators* in the UK, Germany, and Italy alike rely on higher amounts of *institutional* share capital than the average firm in each respective country. Similarly, *Diversified Quality Producers* in each economy resort to more *private* share capital than the average national firm. This, in turn, supports my idea that capital from institutional investors furthers RPI, whereas capital from private investors promotes DQP.

In order to test the robustness of these observations, I carried out several quantitative analyses. First, I correlated a firm's *institutional* (and respectively *private*) *share capital* with the pursuit of an *RPI* (and respectively a *DQP*) *strategy*. The outcome of these analyses shows that a strong correlation exists between a firm's ownership structure and its competitive strategy: the higher the proportion of institutional shareholders, the higher the probability that a firm pursues an RPI strategy ($R=.407$; $R^2=.170$; $p < 0.01$ (2-tailed)). Of course, the opposite statement also applies: the more shares are held by private investors, the more a firm is likely to pursue a DQP strategy ($R=.407$; $R^2=.170$; $p < 0.01$ (2-tailed)).[57]

In line with sections 2.3.3.1 and 2.3.3.2, I also run both binary and multi-nominal logistic regressions so as to analyse the relationship between a firm's ownership structure and its strategy. Since these analyses test the impact of just *one* independent variable on competitive strategy, binary and multi-nominal logistic regressions provide exactly the same results. Howeve, the outcomes of multi-nominal analyses may be easier to read. Therefore, I report the results obtained from two multi-nominal regressions in table 2.8.. While I assessed the impact of *institutional*

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[56] It is important to note that these *relative* figures do not tell us about the *absolute* funds which are provided by institutional and private shareholders respectively. In other words, the observation that shares are overall held roughly to the same extent by institutional (56%) and private (44%) investors does *not* imply that institutional and private investors provide roughly the same amounts of money to firms.

[57] It should be noted that I also ran the respective correlation analyses for each country individually. Importantly, country-specific results do not show any major deviations from the overall results. While the number of cases per country is sometimes not large enough to provide statistically significant outcomes, the relationship between a firm's ownership structure and its strategy is always positive and fairly strong: In line with the results of table 2.7., I find that Radical Product Innovators in the UK ($R=.231$; $R^2=.053$; $p<.25$ (1-tailed)), in Germany ($R=.303$; $R^2=.092$; $p<.12$ (1-tailed)), and in Italy ($R=.670$; $R^2=.449$; $p<.05$ (2-tailed)) use comparatively more institutional share capital. Similarly, Diversified Quality Producers in the UK ($R=.231$; $R^2=.053$; $p<.25$ (1-tailed)), in Germany ($R=.303$; $R^2=.092$; $p<.12$ (1-tailed)), and in Italy ($R=.670$; $R^2=.449$; $p<.05$ (2-tailed)) employ more private share capital to finance their activities.

share capital on *competitive strategy* in the first analysis, I regressed *private share capital* on a firm's *strategy* in the second analysis. In so doing, I used Diversified Quality Production as reference category in both analyses.[58]

Table 2.8.: Impact of Institutional & Private Share Capital on Competitive Strategy (Results of Multi-Nominal Logistic Regression Analyses: Standardised B)

Independent Variable	Analysis 1 Institutional Sh.Cap. → Co.Str. Reference Category: DQP	Independent Variable	Analysis 2 Private Sh.Cap. → Co.Str. Reference Category: DQP
Institutional ShCapital	1.026**	**Private Sh. Capital**	.975**
N	40	**N**	40
R^2 Nagelkerke	.213	**R^2 Nagelkerke**	.213
Significance levels: * < 0.10 ** < 0.05 *** < 0.01			

Table 2.8. confirms the previous result that Radical Product Innovators finance their activities from institutional share capital to a significantly higher degree than Diversified Quality Producers (analysis 1). Conversely, firms pursuing a DQP strategy use significantly more private share capital than firms pursuing an RPI strategy (analyses 2). In sum, we find broad empirical support for the idea that Radical Product Innovators are substantially financed by institutional investors, whereas private investors provide funds to Diversified Quality Producers. This, in turn, can be interpreted in favour of my hypothesis that institutional shareholder finance facilitates RPI, whilst private share capital promotes DQP.

Having found empirical support for my hypothesis, it is time to turn to the question of causal mechanisms. Why does institutional share capital facilitate Radical Product Innovation, whilst private share capital is conducive to Diversified Quality Production? The key to this answer was provided to me when I learned about the shareholder strategy of the Deutsche Telekom AG. When the latter went public in 1997, it was 'the declared aim of the Deutsche Telekom AG (...) to have as many individual investors as possible because they were considered to be long-term shareholders. (...) [Institutional] investors with a more speculative orientation should be not considered.' (Börsch 2003: 201).

[58] As in the previous correlation analyses, I also carried out both multi-value regressions for each country individually. Importantly, country-specific deviations from the overall results cannot be observed. Similarly to the aforementioned correlation analyses, the number of cases per country is sometimes too limited to provide statistically

Importantly, this statement points to the different risk-return preferences of institutional investors on the one hand, and private investors on the other. Let us recall the argument of the competitiveness literature on the impact of insider and outsider share capital (see introduction to section 2.4.1.). This reasoning is essentially grounded on the tacit assumption that *insider shareholders* have a preference for *low-risk, low-return* strategies, whereas *outsider shareholders* prefer *high-risk, high-return* strategies. While it is highly plausible that shareholders with different risk-return preferences exist, it is difficult to understand why such preferences should vary according to the economy's corporate-governance system. Instead, it seems more credible that shareholders with diverse preferences can be found within each economy. It was precisely this reasoning which led me to understand why institutional shareholder capital facilitate Radical Product Innovation, whilst private shareholder capital promote Diversified Quality Production.

Let me begin by elaborating on the risk-return preferences of private investors. Private shareholders, such as founders, managers, or employees, have a personal interest in the survival of 'their' firm. Accordingly, they prefer the latter to engage in Diversified Quality Production – not because this strategy provides comparatively low returns, but because it involves a reduced risk of failure. A similar argument applies to private investors who acquire shares on the stock exchange without entertaining a personal relationship with a firm. Such investors usually lack both the in-depth knowledge and the time to constantly monitor the development of shareholder value, and to compare the latter with returns from alternative investment projects. Individual investors therefore prefer the comparatively small but stable returns which tend to result from the pursuit of a DQP strategy. In sum, given that a reduced risk of failure is essential to private investors, they are disposed to accept lower returns. Therefore, a high amount of private share capital facilitates the pursuit of a DQP strategy because private investors urge the firm's management to pursue a low-risk, low-return strategy.

The opposite holds true for institutional investors like venture capitalists, banks, and funds. Since it is the predominant concern of these investors to realise high returns on investment, they are more willing to accept a high risk of failure. Dedicating important resources to learn about the risk-return ratios of a large variety of investment projects, institutional investors have the necessary in-depth knowledge to choose the most promising projects. In so doing, they prefer investing in radically innovative firms because the latter potentially promise the highest returns (see CPB Netherlands 1997: 346; 348-350; Vitols 2001: 350-352). In other words, institutional investors only provide funds to firms if the latter pursue a high-risk, high-return strategy, because

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significant results. However, all results are strong and, even more importantly, have the predicted direction of correlation.

these shareholders are not interested in low-return projects, even if their risk of failure is reduced. In sum, a high amount of institutional share capital facilitates Radical Product Innovation because institutional investors urge a firm's management to pursue a high-risk, high-return strategy.

Anecdotal evidence, obtained from interviewing the CEO of a biotech firm in February 2005, provides further empirical support for my argument. For reasons of confidentiality, I will call the firm in question BTF-21. Until recently, BTF-21 pursued a low-risk, low-return DQP strategy in that it carried out contract research for other biotech and pharmaceutical companies. As did many other biotech firms, BTF-21 became aware that using its knowledge for the development of its own drugs was more profitable than offering research services to other companies. Hence, BTF-21 decided to try and develop a particularly promising discovery, for which it holds all patents, into a pharmaceutical product on its own. In order to finance the shift from a low-risk, low-return to a high-risk, high-return strategy, BTF-21 considered several financial alternatives. At the time of my interview, the large majority of BTF-21's shares were held by private investors, namely founders and managers. But the latter were unable to cover the amount of finance required for the RPI-project in question. Furthermore, returns from the hitherto pursued low-risk strategy had not yielded enough to finance a high-risk project. BTF-21 therefore turned to institutional shareholders, i.e. venture capitalists, in order to ask for seed finance. Interestingly, the latter agreed to provide funds *as soon as BTF-21 had embarked fully on an RPI strategy*! But as long as BTF-21 continued to concentrate on the pursuit of a low-risk, low-return strategy, venture capitalists were not interested in providing finance. The reason, simply, is that *returns from this strategy were considered stable but too small*! In sum, the experience of BTF-21 illustrates that institutional share capital promotes the pursuit of an RPI strategy because institutional investors urge managers to engage in high-return, high-risk projects.

2.4.3. Acquiring Institutional Share capital in Countries with Public Pension and Insurance Systems

In the introduction to this chapter, I pointed out that my research aims at studying the link between corporate-governance systems, financial input factors, and competitive strategies. Approaching the end of this chapter, I am stunned by the amount of analyses required to identify those financial means which actually facilitate the pursuit of a competitive strategy, while little has been said about how institutions provide these means. Importantly, though, I showed that neither insider nor outsider share capital facilitates the pursuit of a specific strategy (see section 2.4.1.). It is therefore unnecessary to study the extent to which these types of finance are provided by specific regimes of corporate-governance regulation. Nevertheless, it is necessary to ask which

institutions provide those financial means that we found to significantly facilitate a specific strategy. This is essential for understanding whether the competitiveness literature rightly suggests that (only) country-specific institutions enable the provision of specific financial means (see e.g. Vitols 2001: 350-352; Hall and Soskice 2001a: 27; 27-29; CPB Netherlands 1997: 351-354; Bronk 1998: 5-8; Lindgaard Christensen 1992: 146-147; Ohlin 1933: 55). Should this turn out to be the case, it is also interesting to understand how entrepreneurs in different economies secure the required financial means. Accordingly, it is the aim of this section to study the link between institutions and the provision of financial input factors more closely.

Let us recapitulate that we found three types of finance to have a particularly conducive impact on specific strategies, namely *debt finance*, *private share capital* and *institutional share capital*. While debt finance and institutional shareholder finance are required for the pursuit of an RPI strategy, private share capital promotes Diversified Quality Production. Consequently, the question arises to what extent these three types of finance are provided by specific national institutions. The answer to this question is straight-forward for debt finance on the one hand, and private share capital on the other: neither the finance nor the competitiveness literature, nor any other source of information points to country-specific institutions that would further the provision of *debt finance*. This is particularly true in that the process of disintermediation means that firms increasingly obtain credits from economic actors other than banks (see e.g. Schneck 1998: 174-175). Similarly, country-specific institutions which promote the provision of *private share capital* do not seem to exist. Instead, it is presumably most plausible that private investors willing to buy a firm's shares can be found in all economies to the same extent.

Contrary to debt finance and private share capital, national institutions seem to have an impact on the provision of *institutional shareholder finance*. As Aguilera points out, "institutional investors play a minor role in countries where pensions are provided by the state" (Aguilera 1998: 89). The reason for this is that those funds destined for paying (future) pensions are administered by the state in economies with a public pension system. In private pension systems, however, employees tend to lay out an important part of their salaries to pension funds and other pension-scheme providers which re-invest these sums. Consequently, the number of institutional (re-)investors is higher in economies with private pension systems than in countries where pensions are administered by the state. The same reasoning applies to economies with private *insurance* systems. In sum, private pension and insurance systems lead to a more abundant provision of institutional share capital, whereas public pension and insurance systems entail the scare availability of such financial means. The competitiveness literature is thus far

right in suggesting that country-specific institutions have an impact on the provision of specific input factors.

For our case sample, these insights mean that firms should find it rather easy to acquire institutional share capital in the UK, where the government provides only very basic pension and insurance schemes so as to encourage private arrangements (see Stiglitz and Driffill 2000: 369-371). In that, it is useful to remember the results presented in table 2.7. (section 2.4.2.). Interestingly, this table showed that British firms in general, and British RPIs in particular, indeed rely on a particularly high amount of institutional share capital. Yet, table 2.7. also illustrated that German and Italian RPIs finance their activities to a great extent from institutional share capital as well – albeit to a lesser extent than their British counterparts. Hence, the question arises of how Radical Product Innovators in Germany and Italy acquire institutional shareholder finance, given that both countries have a public pension and insurance system. To put it more generally: given that a substantial number of firms pursue an RPI strategy in countries with public pension and insurance systems, how can these firms secure the required share capital considering that institutions lead to its comparatively scarce provision?

Before trying to support my argument empirically, let me briefly answer this question. Entrepreneurs circumvent *national* institutions by importing the required financial means from abroad! Instead of merely relying on funds provided by national investors, Radical Product Innovators in Germany and Italy simply turn to foreign investors. Importing finance in this way is essentially possible due to the existence of international institutions, namely open financial markets. Hence, firms in developed capitalist economies are not at all constrained to the extent that they can only use those types of share capital provided by national institutions. Instead, they avoid the constraints resulting from national pension and insurance systems by drawing on international institutions which give them access to shareholder finance provided in other economies.[59]

It would be time consuming and not particularly representative to try and support this claim empirically by tracing to what extent the German and Italian RPIs of my case sample are financed by foreign and national institutional shareholders respectively. However, aggregate statistics for the German biotech industry provide representative empirical evidence (see

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[59] One might wish to argue that circumventing national institutions *though importation* is better described as factor provision *through foreign national institutions*, because firms import those financial means which emerge from the pension and insurance systems of other economies. However, such factor transfer is only possible in open financial markets. Hence, it is international financial-market regulations rather than foreign pension systems which enables companies to secure input factors from abroad. The best example is provided by the European Community where the free circulation of capital, goods, services and people has been guaranteed since the Single European Act of 1986.

Ernst&Young 2004: 92)[60]. This data shows that the German biotech industry is greatly financed by foreign venture capitalists. More precisely, 42% of venture capitalists which provided finance to German biotech companies in 2003 were foreign investors. Foreign investment is even more important in rounds of financing of more than €5 million. Here, the share of foreign venture capitalists (65%) largely exceeded the share of German venture capitalists (35%) in 2003 (Ernst&Young 2004: 92). Furthermore, it is interesting to note that the importance of foreign venture capital is particularly pronounced in the Italian case. Since Italian venture capital is at the moment virtually inexistent, all venture capitalists investing in Italian biotech firms are foreign investors (Barbanti 2005; see also Breschi, Lissoni, and Orsenigo 2003: 154). In sum, an important part of German biotech firms, and virtually all Italian biotech companies, have acquired institutional share capital required for the pursuit of an RPI strategy from foreign institutional investors.

What do these insights teach us about the link between national institutions, the provision of input factors, and the pursuit of specific competitive strategies? In essence, we find the competitiveness literature right in suggesting that *national* institutions facilitate a specific strategy to the extent that they provide specific types of share capital. Even though the literature wrongly suggests *national corporate-governance systems* to facilitate Radical Product Innovation (Vitols 2001: 350-352; Hall and Soskice 2001a: 27; 27-29; CPB Netherlands 1997: 351-354; Bronk 1998: 5-8; see Lindgaard Christensen 1992: 146-147; Ohlin 1933: 55), we found *private pension and insurance systems* to further this strategy in that they entail the abundant availability of institutional shareholder finance. More importantly, though, we also find the competitiveness literature wrong in their exclusive analytical focus on *national* institutions, which entails a perception of entrepreneurs as mere institution-takers (see Hall and Soskice 2001b in general; and Hall and Soskice 2001a: 56 in particular; see also Porter 1990, chapter 3; Ohlin 1933: 7; 55). This, in turn, prevents the competitiveness literature from explaining how firms can pursue different competitive strategies within a unilaterally facilitative environment. My analyses have revealed that the competitiveness literature is fundamentally wrong in ignoring the extent to which international institutions enable entrepreneurs to secure required input factors. I have illustrated how entrepreneurs actively circumvent national institutions whenever the latter hamper the pursuit of their chosen competitive strategy. I therefore argue that a Schumpeterian perception

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This makes it easier for Radical Product Innovators to secure institutional share capital from EU- rather than non-EU investors.

[60] While not all biotech firms pursue an RPI strategy, I found a strong correlation between a firm's industry and its competitive strategy (see section 2.3.2.1.). Accordingly, a large majority of biotech companies engage in Radical Product Innovation which, in turn, makes it plausible to consider the data on German biotech companies as representative for firms pursuing an RPI strategy in Germany.

of entrepreneurs as independent innovators (see e.g. Schumpeter 1934, chapter 4) is more instructive for understanding how firms gain international competitiveness, even where national institutions are hostile to the pursued strategy.

2.5. Concluding Interpretation

In the present chapter, I studied the extent to which national institutions facilitate an RPI, a DQP, and an LCP strategy respectively by providing specific means of finance. The results obtained from these analyses shed light on the arguments of the competitiveness literature in general, and on the importance of institutions and input factors for the pursuit of diverse competitive strategies in particular. I will conclude my analyses by summarising and interpreting my findings.

To begin with, we found empirical support for two assumptions which are central to my research project. Let us remember that firms can finance their activities from *externally* provided resources (namely share capital and debts), as well as from *internally* generated means (i.e. retained earnings, current liabilities, and other non-current liabilities). Interestingly, we have seen that firms pursuing different competitive strategies vary most notably in the extent to which they use *externally* provided means of finance. On the one hand, this finding justifies the assumption of the competitiveness literature that three input factors (finance, labour qualifications, and component standards) are crucial for the pursuit of any strategy, because a firm cannot provide them on its own but only in collaboration with *external* economic actors (see in particular Hall and Soskice 2001a: 6-7; see also Lundvall 1992a: 13-15; Andersen 1992: 68-69; Patel and Pavitt 1994: 91-92; Hollingsworth 2000: 627-628; 632; Porter 1990: 20). Following this reasoning, I decided to limit my analyses to these three input factors. The finding that financial means provided by *external* investors, but not *internally* generated resources, significantly facilitate specific strategies supports both the argument of the competitiveness literature and my analytical focus.

On the other hand, this finding also sustains my assumption that firms can in essence pursue three competitive strategies. I based the assumption that a distinction between RPI, DQP and LCP is both necessary and sufficient on two grounds: deductive reasoning, and insights gained from the competitiveness literature (see e.g. Ohlin 1933: 7; Sinn 2005: 18-19; Lundvall 1992b: 11-12; 57-59; Freeman 1992: 182; Porter 1990: 10; 37; Hall and Soskice 2001a: 38-39; Estevez-Abe et al. 2001: 148-149; 174-175; Casper 2001: 398-400). Given that these three strategies vary significantly in the extent to which they require specific financial means, each strategy seems to follow a different entrepreneurial logic. In other words, a conceptual correlation

does not, presumably, exist between Radical Product Innovation, Diversified Quality Production, and Low Cost Production. In that, my decision to distinguish between three strategies is empirically justified.

But what have we learned about the link between institutions, the provision of specific financial means, and their impact on competitive strategies? In essence, we found that debt finance on the one hand, and share capital on the other are decisive for the pursuit of specific strategies: Neither a firm's industry, nor its country, its age, or internally generated means of finance facilitate competitive strategies as significantly as these externally provided means of finance. More precisely, we found that an RPI strategy is facilitated by both debt finance and institutional share capital, whereas a DQP strategy is furthered by private shareholder funds. Interestingly, an LCP strategy is autonomous of the provision of specific financial means.

These findings shed light on the arguments of the competitiveness literature in various respects. While the literature rightly points out that debt finance and share capital have a facilitative impact, we have found the literature wrong in its detailed hypotheses. On the one hand, we did not find empirical support for the argument that Diversified Quality Producers and Low Cost Producers finance their activities from debt, whereas Radical Product Innovators abstain from doing so (see Vitols 2001: 352; CPB Netherlands 1997: 353-354; Hollingsworth 2000: 628). In fact, the opposite holds true, as RPIs rely on debt finance more significantly than both DQPs and LCPs. In my view, this misinterpretation springs from an overestimation of the extent to which creditors make their investment decisions dependent on a firm's strategy. While creditors may take a firm's strategy into account when assessing its credit-worthiness, they are more interested in available securities (Schneck 1998: 438; 436-437). Thus, as long as firms possess securities, they will be granted a loan, irrespective of the competitive strategy they pursue. Since Radical Product Innovators are often young (start-up) companies (see section 2.3.2.2.), they have comparatively high funding requirements without the possibility of accumulating internal finances. This explains why firms pursuing an RPI strategy go further into debt than firms pursuing a DQP or an LCP strategy.

On the other hand, we also found the competitiveness literature wrong in suggesting that *outsider* share capital facilitates *RPI*, whereas *insider* share capital furthers *DQP* (Vitols 2001: 350; 359-360; Hall and Soskice 2001a: 27; 39-41; CPB Netherlands 1997: 354-356; see Lindgaard Christensen 1992: 146-147; 162; Ohlin 1933: 7; 55). Instead, we have seen that *private* shareholdings are conducive to *Diversified Quality Production*, whilst *institutional* shareholdings promote *Radical Product Innovation* (see section 2.4.2.). I have argued that this positive relationship is explained by the diverse risk-return preferences of private investors on the one

hand, and institutional investors on the other. In essence, private investors have a predominant interest in a low risk of company failure which makes them willing to accept comparatively low returns. Consequently, a high amount of private share capital facilitates Diversified Quality Production because private investors urge managers to pursue a low-risk, low-return strategy. Unlike private shareholders, institutional investors are particularly interested in realising high returns on their investment. Accordingly, they do not only dedicate important resources to the achievement of this aim, they are also willing to accept a comparatively high risk of failure. Hence, a high amount of institutional share capital facilitates Radical Product Innovation because institutional investors urge managers to pursue a high-return, high-risk strategy.

The identification of those financial means which actually facilitate specific strategies finally allowed me to study which institutions provide these means. Since institutions furthering the provision of debt finance and private share capital do not exist, I focused on how national institutions affect the provision of institutional share capital. In that, I found private pension and insurance systems to be particularly conducive to the pursuit of an RPI strategy, because they entail an affluence of institutional pension-scheme providers. The opposite holds true for public pension and insurance systems, where the state administers the sums invested in pension and insurance schemes. Consequently, I sought to understand how Radical Product Innovators in public pension and insurance systems can secure institutional share capital. My findings on this question are straight-forward: firms circumvent national institutions by *importing* the required financial means from abroad. Instead of relying mostly on funds provided by national investors, Radical Product Innovators in public pension and insurance systems acquire institutional share capital from foreign investors. Importing finance is essentially possible due to open financial markets, which give firms access to the means of finance provided in other economies.

It is precisely this finding which leads me to criticise the competitiveness literature for its exclusive focus on *national* institutions, since the latter entails a perception of entrepreneurs as mere institution-takers (see Hall and Soskice 2001b in general; and Hall and Soskice 2001a: 56 in particular; see also Porter 1990, chapter 3; Ohlin 1933: 7; 55). This, in turn, renders the competitiveness literature unable to explain how firms can pursue different competitive strategies within the same institutional environment. Therefore, I find a Schumpeterian perception of entrepreneurs more helpful in understanding how firms can gain international competitiveness by pursuing different strategies within the same economy. Perceiving entrepreneurs as independent and inventive actors, Schumpeter suggests that the former relentlessly secure all factors required for innovation in order to gain a competitive advantage (in the form of a temporary monopoly) (see e.g. Schumpeter 1934, chapter 4; Schumpeter 1942: 81-106). This is precisely what firms in

Germany and Italy do when they turn to foreign investors in order to acquire institutional share capital. I therefore conclude that firms in the same economy can pursue different competitive strategies because entrepreneurs are independent innovators, not constrained institution-takers.

3. On the Link between Institutions, the Provision of New Component Standards, and Their Impact on Competitive Strategies*

3.1. Entrepreneurs: Constrained Institution-Takers or Voluntaristic Innovators?

> '[S]tandards are one of the leading challenges in contemporary capitalism' (Tate 2001: 446) because '[f]irms [can] use standards to reduce internal and external transaction costs; to drive down prices from suppliers; to block or circumvent competitors; to lock in quasi-monopoly profits through control of a proprietary standard (...); and to set baselines for subsequent rounds of innovation.' (Tate 2001: 442)

This introduction to Tate's study of standards and their impact on competitive strategies illustrates the importance of standards for a firm's daily business. Given this importance, it is interesting that neither the establishment of, nor compliance with standards is *de lege* compulsory – unless explicitly specified in a contract. Firms are entirely free to determine and comply with all sorts of norms. However, *de facto* compliance becomes compelling as soon as more than one firm is involved in a production process, because the standards of semi-finished goods supplied by one firm have to fit those of the processing company. This enables firms to use standards either as a means of large-scale cooperation or as a method for excluding unwarranted competitors. Accordingly, the way in which new component standards are elaborated constitutes an important competitive tool.

The fact that producers need to coordinate with their suppliers in order to elaborate new component standards is the very reason I decided to focus on how this input factor impacts on a firm's competitive strategy[61]. Various strands of the competitiveness literature agree that the

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[61] As pointed out previously (see chapter 1: section 1.4.), a large number of input factors exist which could potentially facilitate the pursuit of a firm's competitive strategy (see e.g. Porter 1985: 85-86; 122; 343-350). However, the competitiveness literature assumes three factors to be decisive for the success of any strategy, namely (1) *financial means*, (2) *labour qualifications*, and (3) new *component standards*. The reason for this is that a firm cannot secure these factors on its own but only following the successful solution of a coordination problem with other economic actors (see in particular Hall and Soskice 2001a: 6-7; see also Lundvall 1992a: 13-15; Andersen

nature of supplier-producer relations are decisive for a firm's competitiveness (Hall and Soskice 2001a: 7; 39-41; Tate 2001; Lundvall 1992b: 13-14; chapter 3; Andersen 1992: 69; 82-91; Gelsing 1992; Hollingsworth 2000: 628; Porter 1990: 71-72; 100-107). Accordingly, the literature acknowledges that 'user-producer relationships are necessary prerequisites for product innovations.' (Lundvall 1992c: 54; see also Lundvall 1992c: 14). In line with their arguments on finance (see chapter 2) and labour qualifications (see chapter 4), proponents of the competitiveness literature suggest that specific types of inter-firm relations determine a firm's innovative capacities (Lundvall 1992c: 57-58; Gelsing 1992: 121-123; Hollingsworth 2000: 628; Hall and Soskice 2001a: 39-41; Tate 2001: 445-446) and, hence, its product-market strategy (Andersen 1992: 87-88; Tate 2001: 445-446; Casper 2001: 404-407; Teubner 2001: 433-435).

Given this general agreement about the importance of supplier-producer relations, it is all the more astonishing that the literature remains extremely vague about the causal mechanisms which link supplier-producer relations to product-market strategies. To give some examples, ''subjective' elements in user-producer relationships' (Lundvall 1992c: 58) and 'information-rich seller-buyer relationships' (Andersen 1992: 83) are found to be important for radical innovation (see also Gelsing 1992: 119; Hollingsworth 2000: 628; Porter 1990: 103). Similarly, 'stable user-producer relationships' (Lundvall 1992c: 57) are said to develop as a result of incremental innovation (see also Hollingsworth 2000: 628; Porter 1990: 103). Finally, low-cost or 'mass-production' (Andersen 1992: 83) – associated with 'a high degree of standardisation' (Lundvall 1992c: 57) and 'information-poor seller-buyer relationships' (Andersen 1992: 82) – is said to enable 'communication between a user and a producer (...) over long distances' (Lundvall 1992c: 57; see also Gelsing 1992: 119).

Interestingly, none of these statements provides an explicit reason for *why* and *how* specific inter-firm relations are required for specific strategies. While some authors point out that differing supplier-producer relations facilitate different types of interactive learning (Lundvall 1992c: 57; Andersen 1992: 82-83) and knowledge accumulation (Andersen 1992: 83-84), the causal mechanisms remain unclear. Furthermore, most strands of the competitiveness literature are confusing not only with regard to causal mechanisms, but also regarding causal directions: are specific supplier-producer relations 'necessary prerequisites for product'-market strategies (Lundvall 1992c: 54), or do the former 'develop' as a result of the latter (Lundvall 1992c: 57)?

1992: 68-69; Patel and Pavitt 1994: 91-92; Hollingsworth 2000: 627-628; 632; Porter 1990: 20). In line with this reasoning, I decided to limit my analyses to these three input factors. The provision of *component standards*, around which the analyses of this chapter are centred, depends on the successful solution of a *hold-up problem* between a firm and its suppliers (see Tate 2001: 442-443; Hall and Soskice 2001a: 26-27; 30-31; Rogerson 1992: 777; Malcomson 1997: 1916-1917). In section 3.2., I will elaborate on this coordination problem and illustrate how its diverse solutions provide different types of standards.

The only strand of the competitiveness literature which allows us to derive straightforward statements about how supplier-producer relations facilitate competitive strategies is the literature on 'varieties of capitalism' (henceforth VoC) (Hall and Soskice 2001a; Tate 2001; Casper 2001; Teubner 2001). As illustrated in the introduction to this section, the VoC literature suggests *standards* to be the causal mechanism which links inter-firm relations to competitive strategies. More precisely, the literature argues that different institutional solutions to the hold-up problem, which emerges whenever suppliers and producers seek to elaborate new component standards, translates into different types of standards (Hall and Soskice 2001a: 26; 31; Tate 2001: 443-446; see Teubner 2001: 433-435). Different standards, in turn, are said to facilitate different competitive strategies (Hall and Soskice 2001a: 26-27; 39-41; Tate 2001: 445-446; see Casper 2001: 404-407; Teubner 2001: 433-435).

Given that the VoC literature proposes the most straightforward statements about the links between institutions[62], the provision of new component standards, and their impact on competitive strategies, I will explicitly address this literature and test its hypotheses in the remaining parts of the chapter. In line with chapter 2 and 4, I will therefore ask:

1. is it true that RPI, DQP, and LCP strategies respectively [63] require a specific type of new component standards (Hall and Soskice 2001a: 26-27; 39-41; Tate 2001: 445-446; see Casper 2001: 404-407; Teubner 2001: 433-435)? Should this turn out to be the case, I will continue by asking:
2. is it true that each of the required standards only emerges from specific institutions, i.e. national antitrust regulations (see Hall and Soskice 2001a: 26; 31; Tate 2001: 443-446; Teubner 2001: 433-435)?

The answers to these questions will not only illustrate how national antitrust regulations facilitate the provision of the specific component standards required for the pursuit of specific strategies, they will also shed light on the causal direction of the relationship between supplier-producer relations and competitive strategies (see Lundvall 1992c: 57-58; Andersen 1992: 82-84; Gelsing 1992: 119; Hollingsworth 2000: 628; Porter 1990: 103).

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[62] In line with Steeck and Thelen (2005: 9-16), I understand institutions as 'formalized rules that may be enforced by calling upon a third party' (Streeck and Thelen 2005: 10).

[63] I took the decision to distinguish between *three* competitive strategies on the grounds of deductive reasoning, and an in-depth review of the competitiveness literature (see e.g. Ohlin 1933: 7; Sinn 2005: 18-19; Lundvall 1992b: 11-12; 57-59; Freeman 1992: 182; Porter 1990: 10; 37; Hall and Soskice 2001a: 38-39; Estevez-Abe et al. 2001: 148-149; 174-175; Casper 2001: 398-400). My assumption that a distinction between three strategies is both sufficient and necessary was empirically confirmed *ex post* by the fact that I could attribute one strategy to each firm of the sample (see chapter 1; section 1.3.2.). Furthermore, operational differences between the three groups of firms turned out to be statistically significant in that each strategy actually requires specific input factors. Thus, the decision to distinguish between three strategies is justifiable both from a theoretical and an empirical perspective.

In attempting to shed light on the link between institutions, standards and strategies, the remaining parts of this chapter are organised as follows. Section 3.2. illustrates the VoC hypotheses on how institutions resolve the hold-up problem related to the elaboration of standards, and how these solutions provide different standards for competitive strategies. In section 3.3., I test the first set of the VoC hypotheses in that I ask which types of standards are actually required for each strategy. In so doing, I find that a firm's strategy *determines* its standardisation approach. However, section 3.4. makes it explicit that standards do *not* constitute a necessary input factor. Instead, a firm's standardisation behaviour is found to *result* from the pursuit of a particular strategy. Therefore, section 3.4. proceeds by questioning the role played by institutions as providers of standards. Interestingly, these analyses lead to the same conclusion reached in chapter 2. I will present this conclusion together with a summary of research findings in section 3.5..

3.2. The VoC Hypotheses: How Different Antitrust Legislation provides Standards for Different Competitive Strategies

The reason for why the competitiveness literature in general, and the VoC literature in particular, assume standards to be decisive for the competitive success of any company is straightforward: a firm cannot simply determine new standards on its own, but only in collaboration with other firms (see in particular Hall and Soskice 2001a: 6-7). Hence, a coordination problem arises whenever suppliers and producers need to agree on the standard for a new product's component(s), since firms have often diverging interests about what this standard should look like. Accordingly, they may find it difficult, or even impossible, to agree on it. Such coordination difficulties are described in the political economy literature as a hold-up problem. A hold-up problem arises whenever two or more parties seek to cooperate with the aim of realising a common goal for the future – in our case with the aim of elaborating a new component standard. However, not all aspects of cooperation are contractible. Therefore, certain aspects of the initial contract may have to be revised in the course of the joint project. At that stage, however, one party has often invested more (money) in achieving the common goal and, therefore, faces higher sunk costs than the other party(s). Since the party with lower sunk costs has comparatively less to gain from continuing cooperation, it may seek to extract advantageous concessions in exchange for its agreement to continue the collaboration. In other words, one party holds-up the common project for strategic reasons (see Rogerson 1992: 777; Malcomson 1997: 1916-1917).

Various contributors to the VoC literature (Tate 2001: 443-444; Teubner 2001: 433-435; Hall and Soskice 2001a: 26-27) point out that such situations of deadlock are prevented or overcome by the extent to which national institutions encourage inter-firm collaboration in standard-setting processes. More precisely, two ways are identified by which national legal systems in general, and antitrust legislation in particular, solve or prevent the aforementioned hold-up problem.

In countries with code-based ('continental') legal regimes, hold-up is overcome by the large-scale coordination of firms. In code-based law systems, antitrust legislation is said to be less stringent in that it incorporates 'a producer-oriented tolerance for sectoral (...) cartels' (Tate 2001: 443). Combined with a fault-based approach to product liability, which is based on the recognition of the *bona fides* principle, firms are encouraged to determine new component standards in encompassing industry associations (Teubner 2001: 433-434; Tate 2001: 443). Such associations are characterised by a large number of members, all paying rather low membership fees. Whenever new component standards are determined, all those concerned parties enjoy the same right to participate in the standardisation process. Hence, both large and small firms have the same say in the design of a new standard (Büthe and Witte 2004: 17-22; see also Tate 2001: 453-454). Thus, hold-up problems are prevented or solved by majoritarian decision processes and an increased propensity to make compromises (see Büthe and Witte 2004: 12). As a result, new component standards are of a *coordinated* nature.

The opposite holds true for countries with a common-law tradition, where deadlock is overcome by small-scale competition between firms. In common-law countries, rigorous antitrust legislation and an open, case-based approach towards product liability is said to discourage large-scale firm-cooperation (Tate 2001: 443-444; see also Teubner 2001: 433-435). Instead of coordinating their interests in encompassing associations, firms set new standards in one of two ways: firstly, they determine them alone by winning a market race. In so doing, firms diffuse their own standard so widely that suppliers and even competitors have to conform if they want to market a decent number of products (Hall and Soskice 2001a: 31). Secondly, firms may come together in small consortia where they elaborate new standards on a contractual basis (idem). Such consortia differ from encompassing associations in that they admit only a limited number of members, which have to pay high membership fees. Furthermore, consortium members often do not have an equal voice in standard-setting processes (Tate 2001: 466-467). 'Big contributors might receive director seats, special voting privileges, earlier technical access, and greater access to any resulting licences; smaller firms might join, if at all, only as observers with highly restricted rights.' (Tate 2001: 466-467). Since consortium-associates do not have the same say in

the elaboration of new standards, deadlock is overcome by powerful members dictating their interests to less powerful members. Consequently, new component standards are of a *competitive* nature.

But how do these two types of standards facilitate the pursuit of different competitive strategies? Various contributors to the VoC literature (Hall and Soskice 2001a: 26-27; Tate 2001: 445-446; see also Teubner 2001: 433-435) argue that *coordinated standards*, resulting from large-scale firm-coordination, promote the pursuit of a *DQP strategy*. The reason for this is that large-scale standardisation encourages all interested firms to contribute their know-how in order to elaborate high-level standards 'that weed out technically inferior outcomes' (Tate 2001: 446). This, in turn, encourages firms to 'focus on product differentiation and niche production' (Hall and Soskice 2001a: 27).

Similarly, the aforementioned scholars (Hall and Soskice 2001a: 30-31; Tate 2001: 445; 468) argue that *competitive standards*, being the result of a market-race or of small-scale firm-collaboration, facilitate the pursuit of an *RPI strategy*. Large-scale standardisation entails the widespread diffusion of substantial knowledge about product or process features. This, in turn, may pose a problem for the protection of property rights (Tate 2001: 455) which is said to be crucial for the pursuit of an RPI strategy: Radical Product Innovators have little to gain from developing a new product if the underlying know-how is then diffused widely during the standardisation process without providing any financial compensation (see Casper 2001: 405). Thus, competitive standardisation furthers Radical Product Innovation in that the winner of a market race has the exclusive right to grant licences. This not only compensates the (financial) efforts of the radical innovator, it also enables the latter to control the extent of knowledge diffusion (see Tate 2001: 468).

In sum, *coordinated standards* are said to further the pursuit of a *DQP strategy*, whereas *competitive standards* are held to promote an *RPI strategy*. But does such a dichotomous framework allow us to develop hypotheses on the pursuit of an LCP strategy? It should be noted that the above-mentioned VoC authors do not make any *explicit* suggestions on how specific standards facilitate an LCP strategy. However, Tate's contribution (Tate 2001) allows us to *derive* several hypotheses. As Tate points out, '[German mass producers and customized producers alike] could (...) use the ready-made standards framework to include a widening array of suppliers. [Accordingly, they] enjoyed an integrated standardisation framework for the entire economy that set high-level base-lines, whether for mass-market goods or more specialised products' (Tate 2001: 454).

This suggests that the use of coordinated standards can be beneficial for both an LCP and a DQP strategy, because large-scale standardisation provides producers with high numbers of suppliers that can deliver the respective standards. Thereby, Low Cost Producers presumably use the broad availability of coordinated standards in a different way to Diversified Quality Producers. As Hall & Soskice (Hall and Soskice 2001a: 26-27) point out, coordinated standards can be used as a means to foster long-term and trust-based relations between suppliers and producers if they decide to collaborate closely, e.g. on quality controls for semi-finished goods (see Casper 2001: 399-400; 406-407; see also Teubner 2001: 433). Thus, if producers use coordinated standards in a cooperative way with their suppliers, they presumably facilitate Diversified Quality Production.

However, Tate also indicates that coordinated standards can be used to promote an LCP strategy. Low Cost Producers can use the large pool of coordinated-standard suppliers as a means to increase price competition because they can shift quickly from one supplier to another as soon as the latter offers cheaper prices. This means that suppliers may be unable or reluctant to fulfil producer requirements which go beyond the formally established standards. Hence, it can be hypothesised that Low Cost Producers prefer to use coordinated standards in a formal way, while Diversified Quality Producers prefer to use coordinated standards in a cooperative way with their suppliers. Consequently, the use of *formally coordinated standards* can be said to facilitate an LCP strategy because it increases price competition among suppliers. The use of *cooperatively coordinated standards*, by contrast, presumably promotes a DQP strategy in that it facilitates the joint quality control of semi-finished goods.

While the *use* of formally coordinated standards seems to further Low Cost Production, the *elaboration* of standards presumably hinders this strategy. As Tate points out, the elaboration of standards is costly (Tate 2001: 467). This is particularly true for small-scale standardisation processes where consortium members often have to pay high membership fees (idem). Yet the large-scale elaboration of *coordinated* standards also requires a substantial investment in terms of time and money (Tate 2001: 446; see also Büthe and Witte 2004: 12). This, in turn, militates against the pursuit of a price-based LCP strategy. In sum, the *elaboration* of any type of standard is probably too expensive for Low Cost Producers, whereas the *use* of *formally coordinated standards* may facilitate the pursuit of an LCP strategy. Coming back to the aforementioned hold-up problem, the latter is circumvented by Low Cost Producers in that they simply do not engage in the elaboration of standards.[64]

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[64] Of course, Low Cost Producers can only free-ride on the use of coordinated standards if a critical mass of firms exists to elaborate this standard-type in order to pursue a DQP strategy. Since the introductory chapter has shown this

The above reasoning allows us to propose three sets of testable hypotheses on the link between standards and competitive strategies. Firstly, regarding the ***elaboration of standards***, it can be hypothesised that Radical Product Innovators (henceforth RPIs) determine *competitive standards*, whereas Diversified Quality Producers (henceforth DQPs) elaborate *coordinated standards*. Low Cost Producers (henceforth LCPs) *abstain from elaborating standards*. Secondly, concerning the ***use of standards***, RPIs should mostly employ *competitive standards*, whilst both DQPs and LCPs rather rely on *coordinated standards*. Finally, regarding the ***use of coordinated standards***, DQPs presumably use *cooperatively coordinated standards* fostering close relationships with suppliers, whereas LCPs merely use *formally coordinated standards* to increase price competition among suppliers. Table 3.1. provides an overview of these three sets of hypotheses. It will be the aim of section 3.3. to test these hypotheses.

Table 3.1.: Hypothetical Relationships between Standards and Competitive Strategies

Hypotheses: **Competitive Strategies:**	**RPI**	**DQP**	**LCP**
H1: Elaboration of...			
...competitive standards	**X**		
...coordinated standards		**X**	
...no standards			**X**
H2: Use of...			
...competitive standards	**X**		
...coordinated standards		**X**	**X**
H3: Use of coordinated standards in...			
...a cooperative way = cooperatively coordinated standards		**X**	
...a formal way = formally coordinated standards			**X**

Source: Own Illustration

critical mass of firms to exist in all the countries studied, the assumption that Low Cost Producers free-ride on large-scale standardisation processes of Diversified Quality Producers can be accepted.

3.3. TESTING THE HYPOTHESES (I): DO SPECIFIC STRATEGIES REQUIRE SPECIFIC STANDARD(I)S(ATION)?

In this section, I will empirically test the first set of hypotheses derived from the VoC literature on the link between component standards and competitive strategies. To this end, three methodological issues need to be addressed. Firstly, how should we operationalise the notion of (*competitive* or *coordinated*) *component standards* used in pharmaceutical products? It should be noted that the VoC scholars ground their arguments on studies of less technology-intense industries, for the most part metal-work (see e.g. Tate 2001). For the products of these industries, the term ***component standard*** refers to *all the characteristics of* ***semi-finished goods*** *which make up the final product.* Accordingly, the component standard of pharmaceutical products can be defined as the *characteristics of all those* ***active and excipient substances*** *which make up a drug.*

Let us furthermore recall that *competitive* standards result from small-scale collaboration between firms on a contractual basis. Consequently, I will refer to the standard for an active or excipient ingredient as ***competitive*** whenever it was *determined by a small number of companies on a contractual basis. Coordinated* standards, on the other hand, result from large-scale collaboration between firms in encompassing industry associations. For industrial goods, the large-scale coordination of component standards takes place in national and international associations such as the Deutsches Institut für Normung (DIN), the British Standards Institution (BSI), or the International Organization for Standardisation (ISO) (see e.g. Tate 2001).

But do comparable associations exist in the pharmaceutical industry, which coordinate the standardisation of new pharmaceutical ingredients on a large scale? Interestingly, this question can be answered with a clear-cut 'yes'. Standard-setting associations exist at both the national and the international level. At the European level, these standardisation processes take place within the *European Pharmacopoeia Commission.* In addition, *national Pharmacopoeia Commissions* exist which determine standards for pharmaceutical ingredients in those areas that are not covered by the European Pharmacopoeia. Like other large-scale associations, it is the task of these Commissions to form and coordinate expert committees and working groups within which new monographs are elaborated. A monograph determines the standards for a pharmaceutical ingredient by describing both its characteristics and preparation. All these monographs together form the *European* (or respectively *British, German, Italian* etc.) *Pharmacopoeia.* Apart from the European and national Pharmacopoeia Commissions, a few other associations exist which coordinate large-scale standardisation, e.g. the German Pharmaceutical Codex (Deutscher Arzneittel-Codex). However, these associations are of minor importance as

they only elaborate pharmaceutical standards in those few areas that are not covered by the European or national Pharmacopoeia (BfArM 2004).

Whenever a new (Pharmacopoeia) monograph is elaborated, all interested parties – e.g. firms, laboratories, experts etc. – are free to participate in the standardisation process. While other procedures exist, interested firms can propose an experienced employee as a member of a newly established working group. For single-source active substances, it may also occur that the Pharmacopoeia Commission turns to the firm which developed the substance in question in order to request its collaboration in elaborating a new monograph. Accordingly, I will refer to a standard for an active or excipient ingredient as ***coordinated*** whenever it was determined by the European or a national Pharmacopoeia, or by a comparable large-scale standardisation association.

The second methodological point concerns the empirical basis on which the subsequent analyses are grounded. In the following, I will test the hypotheses of the VoC literature on the basis of quantitative analyses. I gathered the data for these analyses by carrying out structured interviews with representatives of pharmaceutical firms[65]. While the majority of questions were closed, I also posed several open questions whose answers provided me with precious qualitative insights[66]. The sample of firms, whose representatives I sought to interview, is described in detail in chapter 2 (see introduction to section 2.3.). Of the 110 pharmaceutical firms included in the overall sample, I was granted interviews or obtained information from 65 companies. In small firms, I often interviewed senior managers, i.e. the company's CEO or comparable employee. In large firms, representatives of the company's Quality Assurance department were usually the most adequate interview partners to answer my questions. Apart from quantitative data, these interviews also provided me with important qualitative insights into how different types of standards impact on competitive strategies. It was these insights that enabled me to structure and interpret the subsequent quantitative analyses. Thus, the following analyses are a combination of qualitative and quantitative information.

Finally, it should be noted that I always tested for possible country-specific variations. Let us remember that the VoC literature argues that national institutions have a decisive impact on how standards are determined and used in different economies (Tate 2001: 443-444; Teubner 2001: 433-435; Hall and Soskice 2001a: 26-27; 30-31). In order to assess the stability of the results I obtained from analysing the overall case sample, I cross-checked my findings by re-

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[65] As discussed in chapter 1 (section 1.3.1.) I use the term *pharmaceutical firm* as a generic term for all types of companies which are active in the drug industry, i.e. for biotech-, traditional pharmaceutical-, and generics firms alike.

[66] The questionnaire I used during these interviews is reproduced in the appendix.

running the respective analyses for each country individually. Interestingly, these country-specific analyses agree in one point: while the number of cases is sometimes too small to provide statistically significant results, all country-specific results are perfectly in line with the outcome resulting from the overall sample. This, in turn, confirms my suspicion that national institutions are far less constraining than is suggested by the competitiveness literature in general, and the VoC literature in particular. Since I will elaborate on this argument in section 3.4., suffice it to say here that noteworthy country-specific deviations from the overall results cannot be observed.

That said, let us finally turn to test the three sets of hypotheses on the link between standards and competitive strategy. In line with the trilogy proposed in section 3.2., I test the respective hypotheses in three steps: In section 3.3.1., I assess the impact of the *elaboration* of a standard on competitive strategies, whereas I test the extent to which different strategies *use* specific types of standards in 3.3.2.. In section 3.3.3., I analyses the way in which producers *use coordinated standards* in order to build formal, or cooperative relations with their suppliers. Section 3.3.4. concludes by summarising and interpreting the respective findings.

3.3.1. How Competitive Strategies determine the Elaboration of Standards

If the initial hypotheses on the *elaboration* of pharmaceutical standards hold true, we should find that Radical Product Innovators determine new pharmaceutical standards either on their own, or on a contractual basis in collaboration with a small number of other firms or research organisations (see Casper 2001: 405; Hall and Soskice 2001a: 31; Tate 2001: 445; 468). In contrast, Diversified Quality Producers should actively participate in large-scale standardisation processes coordinated by the Pharmacopoeia Commission or comparable associations (see Tate 2001: 446; Hall and Soskice 2001a: 27). Low Cost Producers, in turn, can be expected to abstain from standardisation processes *per se* (see Tate 2001: 467; 446; Büthe and Witte 2004: 12).

In order to assess the extent to which firms elaborate diverse types of standards, I asked interviewees whether their firm's products contained any ingredients subject to competitive standards. In so doing, I defined a competitive standard as those pharmaceutical ingredients whose features are only known to the firm in question, or to a small number of companies/research organisations. If this was the case, I invited the interviewee to specify what percentage of pharmaceutical ingredients with a competitive standard were elaborated by the firm acting alone, or on a contractual basis with other companies and research organisations. Furthermore, I asked the interviewee whether employees of his/her firm are/were members of a working group/expert committee of the Pharmacopoeia Commission, or of a comparable

standardisation association[67]. Table 3.2. provides an overview of the answers I obtained from interviewees from Radical Product Innovators, Diversified Quality Producers, and Low Cost Producers.

Interestingly, the answers to my three questions follow different patterns for different competitive strategies. This pattern is most straightforward for ***firms which pursue an LCP strategy***. As predicted by the VoC hypotheses, table 3.2. shows that Low Cost Producers do not engage in any standardisation processes: none of the firms interviewed sends or had sent employees to participate in working groups of a Pharmacopoeia Commission, or a comparable standardisation association. Similarly, Low Cost Producers do not elaborate competitive standards alone or with a small number of other firms/research institutes. When asking interviewees why this was, they repeatedly pointed out that their firm does not engage in R&D, but imitates pharmaceutical products developed by others. Accordingly, there is no need to elaborate standards for pharmaceutical ingredients, given that the respective active and excipient substances can simply be imitated upon patent expiry[68]. In sum, empirical evidence supports the hypothesis derived from Tate's contribution (see Tate 2001: 467; 446; Büthe and Witte 2004: 12): Low Cost Producers circumvent the hold-up problem related to the elaboration of new pharmaceutical standards by abstaining from any kind of standardisation.

[67] For the exact phrasing of these questions, please see questions 4.2.1., 4.2.2. and 4.2.4. of the questionnaire reproduced in the appendix.

[68] Some interviewees pointed out that it is occasionally difficult to obtain information about the features of a recently developed active substance for which a Pharmacopoeia (or comparable) monograph does not yet exist. The occasional difficulty in obtaining information on pharmaceutical standards does not, however, entail the necessity of developing alternative standards on a large- or small-scale basis. Instead, Low Cost Producers seek information from sources such as the DIMDI database (see DIMDI 2005), patents and publications, as well as leaflets included in the packets of the original drug. Information obtained from these sources enables employees experienced in the field of galenics to build copies of the original drug's ingredients.

Table 3.2.: Elaboration of Competitive and Coordinated Standards by RPIs, DQPs and LCPs

% of Firms which...	RPIs	DQPs	LCPs
...elaborate competitive standards alone or on contractual basis with few other firms or PROs	100 %	100 %	0 %
...do not elaborate competitive standards alone or on contractual basis with few other firms or PROs	0 %	0 %	100 %
% of Competitive Standards developed...			
...by firm alone	37.4 %	67.2 %	not applicable
...in collaboration with few others	62.6 %	32.8 %	not applicable
% of Firms which...			
...elaborate coordinated standards i.e. send employee(s) to (Pharmacopoeia) working-group(s)	6.2 %	43.3 %	0 %
...do not elaborate coordinated standards i.e. do not send employee(s) to (Pharmacopoeia) working-group(s)	93.8 %	56.7 %	100 %

Source: Own illustration, evaluating questions 4.2.1., 4.2.2. and 4.2.4. (see appendix for questionnaire)

For ***firms that pursue a DQP or an RPI strategy***, table 3.2. reveals more complex standardisation patterns. Contrary to the hypotheses of the VoC literature, we do not find Diversified Quality Producers to elaborate only coordinated (Pharmacopoeia) standards, while Radical Product Innovators focus exclusively on the elaboration of competitive standards (see Casper 2001: 405; Hall and Soskice 2001a: 27; 31; Tate 2001: 445-446; 468). Interestingly, table 3.2. shows that *any* firm which is active in R&D elaborates competitive standards, either on its own or in collaboration with other firms/research organisations. When asking interviewees why this was, it turned out that innovators – whether radical or incremental – do not gain from diffusing the features of a newly elaborated pharmaceutical ingredient through large-scale standardisation. While this supports the argument that competitive standardisation helps to protect a firm's property rights (Tate 2001: 445; 468; see also Casper 2001: 405), this argument applies to Radical Product Innovators and Diversified Quality Producers alike. Consequently, the hypotheses on the predominant importance of competitive standardisation for RPI is shown to lack empirical support (see Casper 2001: 405; Hall and Soskice 2001a: 27; 31; Tate 2001: 445-446; 468).

Interestingly, however, a difference can be observed in the extent to which Diversified Quality Producers and Radical Product Innovators elaborate competitive standards *alone*, and respectively in collaboration *with a small number of other firms or research organisations*. Table

3.2. shows that radically innovative firms elaborate on average 37.4% of competitive pharmaceutical standards alone, and 62.6% in collaboration with others. Incrementally innovative firms, by contrast, elaborate 67.2% of competitive standards alone and only 32.8% in collaboration with other firms/research organisations. Does this finding suggest that competitive standards elaborated *with few others* are relatively more important for the pursuit of an *RPI strategy*, whereas competitive standards elaborated by a firm *alone* are relatively more central to the pursuit of a *DQP strategy*? And if so, why would this be the case?

When thinking about possible reasons, I came across the following web-page statement of Henderson-Morley, one of the pharmaceutical firms contained in my case sample: 'As a drug discovery company, Henderson Morley does not have the *infrastructure* to take projects through the clinical trial process without a commercial partner' (Henderson Morley 2005). We have seen in the introductory chapter that Radical Product Innovators tend to focus on the discovery and early clinical development of pharmaceutical projects. As suggested by Henderson Morley, this means that radically innovative firms need to elaborate new pharmaceutical ingredients in cooperation with other companies or research organisations because they lack the required development and production facilities – such as (access to) animal houses and trial patients, production plants, and expertise in legal requirements. In other words, the pursuit of an RPI strategy makes it difficult for a firm to elaborate competitive standards on its own due to its focus on early value-chain activities.

However, Henderson Morley's statement also suggests a rival hypothesis. The need to elaborate competitive standards with others could simply be the result of a firm's number of employees. Irrespective of a firm's competitive strategy, smaller firms are more likely to have difficulty in elaborating competitive standards on their own, because they lack the necessary expertise in different areas of various value-chain activities. Hence, the 'lack of infrastructure' could be narrowed down to a firm's number of employees.

To assess whether a firm's *competitive strategy* or its *number of employees* is a better explanation of *competitive standardisation with others*, simple linear regression analyses are the most instructive. More precisely, I carried out three regressions. To determine the single impact of an RPI strategy[69] on the one hand (analysis 1), and the number of employees on the other (analysis 2), I first correlated each variable individually with the extent to which a firm elaborates competitive standards with others. In order to assess their relative explanatory power, I then

[69] I created the *RPI-variable* by assigning a score of '1' to all firms pursuing an RPI strategy, whereas I attributed a score of 0 to all firms pursuing a DQP strategy. All Low Cost Producers were excluded from the analyses as none of them engage in competitive standardisation.

regressed the strategy and the employee variable jointly on competitive standardisation (analysis 3). Table 3.3. provides an overview of the results obtained.

Table 3.3.: How an *RPI Strategy* and a Firm's *Number of Employees* impact on *Competitive Standardisation with Others*
(Results of Simple Linear Regression Analyses: Standardised Beta)

Independent Variables	Analysis 1 (RPI → CompStds with Others)	Analysis 2 (NbEees → CompStds with Others)	Analysis 3 (RPI, NbEees → CompStds with Others)
RPI Strategy	.386 ***	---	.425 ***
Number of Employees	---	.061	.163
N	46	46	46
Adjusted R^2	.130	-.019	.136
Significance levels: * < 0.10 ** < 0.05 *** < 0.01			

In essence, table 3.3. illustrates two points: Firstly, the extent to which a firm engages in competitive standardisation with others does not at all depend on its number of employees: Analyses 2 and 3 reveal a very weak and statistically insignificant relationship between the number of employees of a firm and its efforts to elaborate competitive standards with others. Secondly, and contrary to the previous finding, analyses 1 and 3 show that the pursuit of an RPI strategy has a strong and statistically highly significant impact on competitive standardisation. This indicates that the extent to which a firm elaborates competitive pharmaceutical standards with other companies/research organisations is importantly influenced by the competitive strategy it pursues. We can interpret these findings to the effect that, while both RPIs and DQPs elaborate competitive standards, competitive standardisation with others is comparatively more important for Radical Product Innovators than for Diversified Quality Producers. The reason for this is that the focus of Radical Product Innovators on early value-chain activities makes it necessary to compensate for missing infrastructures through joint standardisation projects.

Before I continue to assess how the elaboration of specific standards impacts on competitive strategies, I want to draw attention to another finding that results from the previous analyses. Remember that Low Cost Producers had to be excluded from these analyses as they do not engage in competitive standardisation. Consequently, the results of table 3.3. do not only tell us that the pursuit of an *RPI strategy* makes a firm elaborate competitive standards *together with other companies and research organisations*. We also learn that firms pursuing a *DQP strategy*

show a high propensity to elaborate competitive standards *on their own*. Since I will discuss this finding in extenso in section 3.3.2., suffice it to say here that competitive standardisation by a firm acting alone seems to be important for the pursuit of a DQP strategy.

Having assessed the link between *competitive* standardisation and an *RPI strategy*, let us test whether *coordinated* standardisation is central to the pursuit of a *DQP strategy*. To this end, we should remember that coordinated standardisation is said to facilitate Diversified Quality Production because high-level standards are determined 'that weed out technically inferior outcomes' (Tate 2001: 446). This, in turn, encourages firms to 'focus on product differentiation and niche production' (Hall and Soskice 2001a: 27; see also Tate 2001: 446). When looking at the summary results of table 3.2., this hypothesis seems to be confirmed. While not all firms pursuing a DQP strategy engage in coordinated standardisation (43.3%), the majority of Diversified Quality Producers (56.7%) send employees to participate in Pharmacopoeia (or comparable) working groups. This stands in stark contrast to Radical Product Innovators which almost entirely abstain from coordinated standardisation (93.8 %).

This finding should not, however, lead us to draw premature conclusions. When I asked interviewees why their firm did not participate in coordinated standardisation, representatives of smaller companies often pointed out that their firm simply did not have the necessary human resources. Hence, it could also be possible that the extent to which a firm participates in the elaboration of coordinated (Pharamcopoeia) standards is not related to the pursuit of a DQP strategy. Instead, it could merely depend upon the number of a firm's employees. Accordingly, the following rival hypothesis can be formulated: irrespective of its competitive strategy, a company with many employees finds it less costly than a firm with few employees to send these to a (Pharmacopoeia) working group (see Büthe and Witte 2004: 19-20).

In order to test whether a *DQP strategy* or a firm's *number of employees* constitutes a better explanation of *coordinated standardisation*, binary logistic regression analyses are most instructive. Overall, I carried out three analyses. In the first analysis, I assessed the individual impact of a DQP strategy[70] on coordinated standardisation. Similarly, I tested the importance of a firm's number of employees for coordinated standardisation in the second analysis. In order to determine the relative explanatory power of a DQP strategy and the number of employees, I regressed both variables jointly on coordinated standardisation in the third analysis. The outcome of these three analyses are reported in table 3.4..

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[70] I obtained the *DQP-variable* from assigning a score of '1' to all firms pursuing a DQP strategy, and of '0' to all firms pursuing an RPI strategy. All Low Cost Producers were excluded from the analyses as none of the latter engage in coordinated standardisation.

Table 3.4.: How a *DQP Strategy* and a Firm's *Number of Employees* impact on *Coordinated Standardisation*
(Results of Binary Logistic Regression Analyses: Unstandardised B)

Independent variables	Analysis 1 (DQP → Elab.Coor.Stds.)	Analysis 2 (NbEees → Elab.Coor.Stds.)	Analysis 3 (DQP, NbEees → Elab.Coor.Stds.)
DQP Strategy	2.440**	---	1.796
Number of Employees	---	.001**	.000*
N	46	46	46
R^2 Nagelkerke	.226	.311	.388
Significance levels: * < 0.10 ** < 0.05 *** < 0.01			

Contrary to the expectations of the VoC contributors (Tate 2001: 446; Hall and Soskice 2001a: 26-27), the results presented in table 3.4. contradict the hypothesis on the importance of coordinated standards for the pursuit of a DQP strategy. At first sight, the outcome of analysis 1 seems to provide empirical support for the idea that Diversified Quality Producers engage in coordinated standardisation more than Radical Product Innovators, as a strong positive correlation can be observed ($B = 2.440$; $R^2_{Nagelkerke} = .226$; $p < .05$). However, analysis 2 reveals an even stronger relationship between a firm's number of employees and the extent to which a company participates in the elaboration of coordinated standards ($B = .001$; $R^2_{Nagelkerke} = .311$; $p < .05$). Overall, this means that only the number of employees qualifies as a significant predictor in analysis 3: the pursuit of a DQP strategy does not have any significant impact on the elaboration of coordinated standards[71].

These findings suggest that coordinated standardisation does not help to 'weed out technically inferior outcomes' (Tate 2001: 446). Instead, the advantage of coordinated standardisation seems to be of a different nature: coordinated standards are particularly important in the pharmaceutical industry because legislation is very demanding with regard to drugs' purity standards. Whenever a pharmaceutical company seeks to register a new product, it must demonstrate that all contained actives and excipients are adequately pure. Thereby, the European and national Pharmacopoeia (as well as comparable sources of coordinated standards) serve as

[71] Presumably the number of employees of a company has an even stronger impact on coordinated standardisation than portrayed in table 3.4.. The reason for this is that, in the present analyses, I only considered *whether* a firm sends employees to Pharmacopoeia working groups. I did not consider *how many* people are sent. However, my interviews show that large pharmaceutical companies often send several employees to participate in coordinated (Pharmacopoeia) standardisation, whereas smaller firms tend to send just one representative. This confirms the idea that a firm's human resources are actually crucial for the extent to which a firm engages in coordinated standardisation – irrespective of its competitive strategy.

important benchmarks. Whenever a coordinated (Pharmacopoeia) monograph is elaborated, pharmaceutical companies are free to determine standards that go beyond these quality requirements. But as soon as a monograph exists, a marketing authorisation will only be granted if all the ingredients of a pharmaceutical product fulfil *at least* the monograph's standards. While it is certainly costly to send an employee to participate in a Pharmacopoeia (or comparable) working group, participating firms can make sure that the new monograph is in line with their needs and capacities (e.g. their manufacturing procedures). As a result, the approval and renewal of a pharmaceutical product can be obtained more easily (BfArM 2004). While this advantage is potentially equally beneficial for radically and incrementally innovative firms, only larger companies have the human resources necessary to participate in coordinated standardisation.

To conclude, what have we learned from the previous analyses of the elaboration of different standards? Most importantly, we found that the pursuit of a specific competitive strategy determines a firm's standardisation behaviour – although in a different manner than that predicted by VoC scholars (see Casper 2001: 405; Hall and Soskice 2001a: 27; 31; Tate 2001: 445-446; 467-468). Interestingly, a firm's standardisation approach differs most notably between non-innovative companies (LCPs) and innovative firms (RPIs and DQPs). We have seen that Low Cost Producers ***abstain from*** both competitive and coordinated ***standardisation***. This, in turn, confirms the hypothesis derived from the VoC literature (see Tate 2001: 467; 446; Büthe and Witte 2004: 12): LCPs simply circumvent the hold-up problem related to the elaboration of new component standards.

In contrast to Low Cost Producers, we found both radically and incrementally innovative firms to engage in ***competitive standardisation*** in order to protect their innovative efforts (see Casper 2001: 405). This finding contradicts the VoC hypothesis that competitive standardisation only facilitates an RPI strategy. Similarly, we found the VoC literature wrong in that it overestimates the importance of ***coordinated standardisation*** for the pursuit of a DQP strategy (Tate 2001: 446; Hall and Soskice 2001a: 26-27). While coordinated standardisation is beneficial for radically and incrementally innovative firms alike, as it facilitates the (re-)approval of pharmaceutical products, only large firms have the manpower to participate in coordinated standardisation. We can therefore conclude that radically innovative firms do not resolve the hold-up problem related to the elaboration of new component standards through competitive standardisation, whereas incrementally innovative firms resort to coordinated standardisation. Instead, depending on their (human) resources, RPIs and DQPs use both solutions to remedy the problem of hold-up.

3.3.2. How Competitive Strategies determine the Use of Standards

Having tested the VoC hypotheses on the *elaboration* of standards, let us now turn to analyse whether the *use* of specific standards furthers the pursuit of specific strategies. If the VoC scholars are right (Hall and Soskice 2001a: 26-27; 30-31; 39-41; Tate 2001: 445-446; 454; 468; see also Teubner 2001: 433-435), we should find that Radical Product Innovators rely almost exclusively on competitive standards, whereas both Diversified Quality Producers and Low Cost Producers use coordinated standards. More precisely, the active and excipient components of the pharmaceutical products of *radically innovative* firms should be based on individual standards which are not described in the (European) Pharmacopoeia. *Incrementally innovative* firms and Low Cost Producers, instead, should base their active and excipient components on Pharmacopoeia standards.

To assess how the use of diverse standards impacts on competitive strategy, I posed 5 questions to my interviewees. To begin with, I asked *(1a)* to what extent pharmaceutical ingredients contained in the firm's products are based on (coordinated) Pharmacopoeia standards, and respectively *(1b)* on (competitive) individual standards which are not described in the Pharmacopoeia. If a firm's products contained competitive (individual) component standards, I invited the interviewee to specify *(2)* to what extent these standards are patent-protected; and *(3)* to what extent standards are individual because a Pharmacopoeia monograph does not (yet) exist. If the latter question revealed that a firm uses individual specifications even though a Pharmacopoeia monograph exists, I enquired *(4)* about the reasons for which the firm does not use the respective Pharmacopoeia monograph. Finally, whenever a firm's products contained pharmaceutical ingredients based on Pharmacopoeia standards, I asked the interviewee *(5)* why their firm makes (important) use of such coordinated standards.[72]

Table 3.5. provides an overview of the interviewees' responses to the first three questions. Interestingly, the table indicates that firms pursuing different strategies vary in the extent to which they use specific standards; but these variations are not as pronounced as predicted by the initial hypotheses. Most importantly, no competitive strategy seems to require the exclusive use of coordinated or competitive standards. Instead, Radical Product Innovators, Diversified Quality Producers, and Low Cost Producers alike employ both coordinated and competitive standards. Hence, the question arises of *in what respect* and, even more importantly, *why* empirical evidence deviates from the hypotheses of the VoC scholars (Hall and Soskice 2001a: 26-27; 30-31; 39-41; Tate 2001: 445-446; 454; 468; see also Teubner 2001: 433-435).

Table 3.5.: Use of Competitive and Coordinated Standards by RPIs, DQPs and LCPs

% of Actives and Excipients...	RPIs	DQPs	LCPs
...based on Coordinated Standards i.e. on specifications defined in Pharmacopoeia	42.7 %	78.4 %	90.9 %
...based on Competitive Standards i.e. on specifications which are *not* defined as such in Pharmacopoeia	57.3 %	21.6 %	9.1 %
% of Competitive Standards which are...			
... patent-protected	82.5 %	37.0 %	0 %
... *not* patent-protected	17.5 %	63.0 %	100 %
% of Competitive Standards for which...			
... a Pharmacopoeia-Equivalent does *not* exist	99.2 %	80.1 %	91.7 %
... a Pharmacopoeia-Equivalent exists.	0.8 %	19.9 %	8.3 %

Source: Own illustration, evaluating questions 4.1.1. – 4.1.3. (see appendix for questionnaire)

In line with the findings of section 3.3.1., table 3.5. indicates that Low Cost Producers follow the predicted patterns most closely. The vast majority (namely 90.9%) of active and excipient substances contained in the pharmaceuticals of Low Cost Producers are based on coordinated standards as specified in the Pharmacopoeia (or comparable). When I asked interviewees about the nature of the few (i.e. 9.1%) competitive standards, it turned out that the latter are not included in the Pharmacopoeia because they are imitations of recent inventions whose patent protection has only just expired. Accordingly, the inventor of the original pharmaceutical ingredient has not yet had the time to – or maybe no interest in – diffusing her invention through coordinated standardisation. In other words, the few competitive standards used by Low Cost Producers are *still* competitive as they are *not yet* included in the Pharmacopoeia. Therefore, firms pursuing an LCP strategy do not hold patents for any of the competitive standards contained in their drugs. This explains why none of the competitive pharmaceutical ingredients used by Low Cost Producers are patent-protected (see table 3.5.).

But how to explain the result that Low Cost Producers use 8.3% of competitive standards for which a Pharmacopoeia equivalent exists? The answer to this question is particularly interesting, as we will see below that it is also relevant to the pursuit of a DQP strategy. Several interviewees pointed out that their firm occasionally needs to use competitive standards whose

[72] For the exact phrasing of these questions, please consult questions 4.1.1. – 4.1.5. of the questionnaire (see

quality features go beyond an existing Pharmacopoeia standard because the *responsible approving authority asks them to do so*. This, in turn, indicates that the inventor of the original competitive standard has improved an existing Pharmacopoeia monograph in such a way that the approving authority no longer accepts the use of the original Pharmacopoeia standard. Instead, the authority asks for the use of the improved and therefore competitive standard.

In sum, we find empirical support for the hypothesis derived from Tate's contribution to the VoC literature (Tate 2001: 454), which states that the use of coordinated standards is particularly important for Low Cost Production. We have seen that Low Cost Producers resort to Pharmacopoeia standards whenever possible. While they would wish to use coordinated standards exclusively, firms pursuing an LCP strategy occasionally have to employ competitive standards. The reasons for this are either that a Pharmacopoeia monograph does not yet exist, or that a monograph exists but additional requirements need to be fulfilled in order to obtain a marketing authorisation.

Having found empirical support for the importance of coordinated standards for Low Cost Producers, let us test whether Radical Product Innovators use mostly competitive standards, while Diversified Quality Producers rely chiefly on coordinated standards (see Hall and Soskice 2001a: 26-27; 30-31; 39-41; Tate 2001: 445-446; 468; see also Teubner 2001: 433-435). In line with the findings of section 3.3.1., table 3.5. shows at a glance that these hypotheses do not hold. Firms which pursue an RPI strategy, as well as their counterparts pursuing a DQP strategy, rely substantially on both coordinated and competitive standards. Nevertheless, table 3.5. also reveals that Radical Product Innovators use more competitive (57.3%) than coordinated (42.7%) standards, whereas Diversified Quality Producers rely more on coordinated Pharmacopoeia monographs (78.4%) than on competitive specifications (21.6%).

This suggests that, even though no empirical evidence can be found for the *absolute* importance of competitive or coordinated standards, the two standard types might be of *relative* importance for the pursuit of RPI and DQP strategies respectively. Two simple correlation analyses allow us to assess whether Radical Product Innovators use significantly more competitive standards than Diversified Quality Producers – and vice versa. Indeed, these analyses show that a strong positive and statistically significant relationship not only exists between the pursuit of a DQP strategy and the extent to which a firm uses coordinated standards ($R_{Pearson}$ = .201; R^2 = .041; $p < 0.10$ (1-tailed test)); a positive and even stronger correlation can also be

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appendix).

observed between an RPI strategy and the use of competitive standards ($R_{Pearson} = .596$; $R^2 = .355$; $p < 0.01$ (2-tailed test))[73]. These findings make it tempting to accept the initial hypotheses.

However, before drawing premature conclusions, let us delve into these results in order to get to the bottom of the *reasoning* proposed by the VoC scholars (see Tate 2001: 445; 468; Casper 2001: 405; Hall and Soskice 2001a: 30-31). In section 3.3.1., we found the VoC literature wrong in suggesting that Diversified Quality Producers substantially rely on coordinated standards *because they 'weed out technically inferior outcomes'* (Tate 2001: 446). Instead, we saw that both Radical Product Innovators and Diversified Quality Producers elaborate coordinated standards whenever they have the *human resources necessary* in order to do so. We have also seen in sections 3.3.1. and 3.3.2. that firms pursuing an RPI and a DQP strategy elaborate and use competitive standards. So far, we have simply accepted the VoC reasoning that firms rely on competitive standards *because the latter make it easier to protect innovations from imitation* (see Casper 2001: 405; Tate 2001: 445; 468; Hall and Soskice 2001a: 31). It will be the aim of the remaining part of section 3.3.2. to assess the validity of this reasoning.

So, how to explain that Radical Product Innovators make a relatively high use of competitive standards? To answer this question, table 3.5. provides precious insights as it shows that firms pursuing different strategies vary notably in the extent to which their competitive standards are patent-protected. The fact that a new pharmaceutical ingredient can be protected from unwarranted imitation not only through competitive standardisation but also through patents allows us to test the reasoning of the VoC scholars (see Casper 2001: 405; Tate 2001: 445; 468; Hall and Soskice 2001a: 31). Accordingly, we can formulate the following hypothesis: if it is true that firms use competitive standards in order to protect their innovations, we should find that those companies whose products contain a comparatively *low* share of patent-protected ingredients should make a *more pronounced use* of competitive standards in order to shelter the non patent-protected ingredients from imitation.

To assess the *relative* explanatory power of this hypothesis, the following rival hypothesis can be formulated. Remember the finding of section 3.3.1 that the focus on specific value-chain activities constitutes an important explanation of the extent to which firms elaborate competitive standards on their own or in collaboration with others. In line with this reasoning, we can hypothesise that Radical Product Innovators use comparatively more competitive standards because of their focus on early value-chain activities: the discovery of new chemical entities is,

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[73] It should be noted that I run the two correlation analyses on the basis of the overall firm sample including Low Cost Producers. When excluding all Low Cost Producers from the sample, the correlation between an *RPI/DQP strategy* and the extent to which a firm *uses competitive/coordinated standards* is equally strong for RPI and, accordingly, significantly stronger for DQP ($R_{Pearson} = .544$; $R^2 = .296$; $p < 0.01$ (2-tailed test)).

simply, the raison d'être of radically innovative firms; it is the core business of Radical Product Innovation. Low Cost Producers, on the other hand, hardly use any competitive standards, as they abstain from R&D due to their focus on downstream value-chain activities. Accordingly, Diversified Quality Producers are presumably situated in between these two.

In order to assess whether the extent to which firms use competitive standards is better explained by the necessity to protect innovations or by their focus on specific value-chain activities, I carried out three simple linear regression analyses. In the first two analyses, I tested the absolute explanatory power of (1) the *need to protect innovations* (taking the *extent of patent-protected standards* as a proxy), and of (2) a firm's *focus on specific value-chain activities* (using *competitive strategy* as proxy). In the third analysis, I determined the relative importance of the two explanations by regressing them jointly on the use of coordinated standards.[74] Table 3.6. summarises the results obtained from these analyses.

Table 3.6.: How the *Necessity to Protect Innovations* and the *Value-Chain Focus* impact on the *Use of Competitive Standards*
(Results of Simple Linear Regression Analyses: Standardised Beta)

Independent variables	Analysis 1 (PatProt → UseCompSt)	Analysis 2 (CoStr → UseCompSt.)	Analysis 3 (PatProt; CoStr → UseCompSt.)
Patent-Protection	.359**	---	-,102
Competitive Strategy	---	.588***	.660***
N	49	53	49
R^2	.129	.346	.352
Significance levels: * < 0.10 ** < 0.05 *** < 0.01 (2-tailed test)			

At first sight, table 3.6. seems to provide empirical support for the reasoning of the VoC scholars (see Casper 2001: 405; Tate 2001: 445; 468; Hall and Soskice 2001a: 31). Analysis 1 reveals a strong and statistically significant correlation between the use of patent-protected and competitive standards ($R_{Pearson} = .359$; $R^2 = .129$; $p < 0.05$ (2-tailed test)). Importantly, however, this correlation is *positive*, not negative as predicted by the VoC scholars. In other words, the more a firm uses competitive standards, the more the latter are patent-protected. Furthermore, analysis 2 shows that a firm's competitive strategy provides an even stronger

explanation for why a company uses competitive standards ($R_{Pearson} = .596$; $R^2 = .355$; $p < 0.01$ (2-tailed test)). As it is perfectly in line with the previous correlation analyses, this outcome can be interpreted to the effect that firms use competitive standards as a function of their focus on specific value-chain activities. Overall, this explanation appear as so much better than any other argument related to (patent) protection of innovations, that only a firm's strategy qualifies as a strong and statistically significant predictor in analysis 3.

So, what do these results teach us about the use of competitive standards on the one hand, and the possibilities to protect innovations from unwarranted imitations on the other? To begin with, we find that the two are unrelated. Contrary to the predictions of the VoC scholars (see Casper 2001: 405; Tate 2001: 445; 468; Hall and Soskice 2001a: 31), firms do not use competitive standards to protect innovations from imitation. Instead, firms use competitive standards according to the value-chain focus of their competitive strategy: while the search for new chemical entities and, hence, the focus on upstream activities makes the use of competitive standards more central to the business of Radical Product Innovators, the opposite holds true for Low Cost Producers, whereas Diversified Quality Producers are situated in between. Furthermore, we have seen that the more a firm uses competitive standards, the more they are patent-protected (analysis 1 of table 3.6.). Combined with the previous finding, this indicates that radical innovations can be patent-protected more easily than incremental innovations. Interestingly, this interpretation also emerges from table 3.5., which shows that Radical Product Innovators patent-protect to a greater extent than Diversified Quality Producers. This allows us to conclude that incremental innovations are sometimes not innovative enough to obtain patent protection.

As a corollary of the VoC reasoning (see Casper 2001: 405; Tate 2001: 445; 468; Hall and Soskice 2001a: 31), these findings raise an interesting question which I wish to address before summarising the results of this section. Given that firms do not use competitive standards to protect innovations from imitation, and given that incremental innovations are sometimes not innovative enough to obtain patent protection, how do Diversified Quality Producers protect their incremental innovations from unwarranted imitation? In the course of my interviews, I discovered that, essentially, two ways exist in which Diversified Quality Producers try to protect *incremental* innovations *for which patent protection cannot be obtained* from imitation. On the one hand, they elaborate new pharmaceutical standards on their own. Remember the finding of section 3.3.1. that, contrary to Radical Product Innovators, Diversified Quality Producers show a

[74] In line with the precedent correlation analyses, I run these analyses on the basis of the overall firm sample including Low Cost Producers. Interestingly, the results obtained are so stable that they do not significantly change if

significant propensity to elaborate competitive standards on their own. In so doing, they minimise the risk that potential imitators learn about their innovative efforts.

Secondly, Diversified Quality Producers also seem to use the improvement of existing Pharmacopoeia standards as a 'sheltered' source of incremental innovation. Looking at table 3.5., we find that firms pursuing a DQP strategy use almost 20% of competitive standards for which a Pharmacopoeia standard exists. This stands in stark contrast to Radical Product Innovators (0.8%) and Low Cost Producers (8.3%) alike. When I asked interviewees of DQPs why their firm uses competitive standards even though coordinated Pharmacopoeia standards could be employed, it turned out that Pharmacopoeia monographs constitute a source of 'sheltered' incremental innovation. In 2004, a European Medicines Agency guideline was adopted which invites pharmaceutical firms to develop an in-house monograph whenever the (quality-) requirements of a Pharmacopoeia monograph are insufficient (EMEA 2004). In accordance with this guideline, Diversified Quality Producers regularly propose incremental improvements to existing Pharmacopoeia monographs.

These incrementally improved standards are fairly difficult to imitate. Once a company obtains a marketing authorisation for a pharmaceutical product based on an improved Pharmacopoeia standard, the latter automatically becomes the new *de facto* benchmark for all firms that want to use this standard in the future. That is, every imitator which uses the *original* Pharmacopoeia standard will only be granted a marketing authorisation if the quality level of the improved in-house standard is reached. Remember our previous finding that LCPs use an average of 8.3% competitive standards for which a Pharmacopoeia equivalent exists *because the approving authority asks them to do so*. However, the fact that incremental improvements of Pharmacopoeia standards are usually not patent-protected makes it difficult for imitators to understand how the respective improvements have been achieved. The reason for this is that, unlike patents, the registration documents of a pharmaceutical product cannot be accessed by other pharmaceutical firms. Therefore, incremental improvements of coordinated Pharmacopoeia standards cannot be imitated easily. In that, they constitute a source of sheltered incremental innovation and, hence, of competitive advantage for Diversified Quality Producers.[75]

Low Cost Producers are excluded from the sample.

[75] Admittedly, it is impossible to verify such qualitative reasoning through quantitative analyses. Nevertheless, it is interesting to note that empirical evidence supports my argument that Diversified Quality Producers use Pharmacopoia standards as a source of incremental and 'imitation-protected' innovation. A correlation analysis reveals a strong positive and statistically significant relationship between the pursuit of a DQP strategy and the extent to which firms use competitive standards for which a Pharmacopoeia equivalent exists. This is true whether Low Cost Producers are included ($R_{Pearson} = .337$; $R^2 = .114$; $p < 0.05$ (2-tailed test)), or excluded from the analyses ($R_{Pearson} = .403$; $R^2 = .162$; $p < 0.01$ (2-tailed test)).

To conclude, what do the above findings teach us about the validity of the VoC hypotheses on the use of different standards (Hall and Soskice 2001a: 26-27; 30-31; 39-41; Tate 2001: 445-446; 454; 468; see also Teubner 2001: 433-435)? In line with the previous section, we find that differences in the extent to which firms use specific types of standards are most pronounced between non-innovative firms (LCPs) and innovative companies (RPIs and DQPs). While Low Cost Producers occasionally find themselves obliged to use competitive standards, they resort to coordinated standards wherever possible. On the one hand, this finding verifies the hypothesis derived from Tate's contribution to the VoC literature (see Tate 2001: 454). On the other hand, it also confirms our conclusion of the previous section that Low Cost Producers circumvent the hold-up problem related to the elaboration of standards by free-riding the coordinated standardisation system.

Contrary to the findings on Low Cost Production, the hypotheses of the VoC literature on the importance of competitive standards for Radical Product Innovation, and of coordinated standards for Diversified Quality Production standards must be rejected (see Hall and Soskice 2001a: 26-27; 30-31; 39-41; Tate 2001: 445-446; 468; see also Teubner 2001: 433-435). To begin with, we did not find empirical support for the *absolute* importance of competitive/coordinated standards for the pursuit of an RPI/DQP strategy. Yet we have seen that competitive standards are *relatively* more important for Radical Product Innovation , whereas coordinated standards are relatively more important for Diversified Quality Production. While it is tempting to interpret this finding in favour of the VoC hypotheses, we found the latter to be wrong in that they misunderstand the underlying causal mechanisms (see Casper 2001: 405; Tate 2001: 445; 468; Hall and Soskice 2001a: 31): radically innovative firms do *not* use relatively more competitive standards with the aim of protecting their innovative efforts from imitation. Instead, we found that the extent to which firms use competitive standards instead depends on their competitive strategy, as the latter determines a firm's focus on specific value-chain activities. In line with section 3.3.1., we can therefore conclude that Radical Product Innovators and Diversified Quality Producers alike solve the hold-up problem related to standardisation in both a competitive and a coordinated way - depending on the value-chain focus of their competitive strategy.

3.3.3. How Competitive Strategies determine the Use of Coordinated Standards

The previous section demonstrated that both Diversified Quality Producers and Low Cost Producers use coordinated standards. While they do not employ coordinated standards exclusively, both strategies rely on them substantially (see table 3.5.). In section 3.2., we derived

the hypothesis from various VoC contributions that coordinated standards facilitate the pursuit of a DQP strategy if producers employ them in a cooperative way with suppliers in order to establish long-term and trust-based relations (see Hall and Soskice 2001a: 26-27; Casper 2001: 399-400; 406-407; Teubner 2001: 433). On the other hand, we also hypothesised that the use of coordinated standards can promote an LCP strategy if producers use them in a formal way with their suppliers in order to increase price competition (see Tate 2001: 454). The aim of section 3.3.3. will be to assess whether the *use of cooperatively coordinated standards* promotes *Diversified Quality Production*, whereas the *use of formally coordinated standards* furthers *Low Cost Production.*

If these hypotheses hold true, we should find that Low Cost Producers change their suppliers more often than Diversified Quality Producers. Furthermore, the relationship between producer and suppliers should be of a collaborative nature where the former pursues a DQP strategy. On the other hand, the relationship may be presumed to be strained where the producer pursues an LCP strategy. To test these hypotheses, I posed three questions to interviewees[76]. Firstly, they were invited to specify the number of years for which their firm had collaborated with its three most important suppliers. Secondly, I asked about the period for which the average supplier works for the interviewee's company. In the third question, I invited interviewees to specify the quality of their firm's relationship with its three most important suppliers. Table 3.7. summarises the answers given by interviewees from Diversified Quality Producers and Low Cost Producers.

Table 3.7.: Supplier-Producer Relations of DQPs and LCPs

	DQPs	LCPs
Average time of collaboration with 3 most important suppliers (in years)	11.6 years	11.1 years
Years for which a supplier works for producer on average	8.3 years	8.5 years
Relationship between suppliers and producer (1 - very strained; 5 - very collaborative)	4.1	3.4

Source: Own illustration, evaluating questions 4.3.1. – 4.3.3. (see appendix for questionnaire)

In a word, the empirical evidence reported in table 3.7. does not provide clear-cut support for the hypothesis that Diversified Quality Producers use coordinated standards as a means to

[76] For the exact phrasing of these questions, please consult questions 4.3.1. – 4.3.3. of the questionnaire (see appendix).

foster close relationships with suppliers, whereas Low Cost Producers use them as a means to increase price competition (see Tate 2001: 454; Hall and Soskice 2001a: 26-27; Casper 2001: 399-400; 406-407; Teubner 2001: 433). On the one hand, Diversified Quality Producers collaborate for roughly the same amounts of time with their three most important suppliers as Low Cost Producers, as well as with their average supplier. On the other hand, however, interviewees from DQPs characterised the relationship with their firm's suppliers as more collaborative than interviewees from LCPs.

So, let us resort to quantitative analyses in order to analyse whether the summary results of table 3.7. are statistically significant. In so doing, let us begin with testing the duration and quality of supplier-producer relations on the basis of three simple correlation analyses. As indicated by table 3.7., the first analysis shows that no statistically significant correlation exists between a firm's *competitive strategy* and the *period for which it collaborates with its 3 most important suppliers* ($R_{Pearson} = .038$; $R^2 = .001$; $p > 0.10$ (2-tailed test)). The same finding emerges from the second analysis, which reveals that no significant correlation can be observed between a company's *strategy* and the *duration of collaboration with its average supplier* ($R_{Pearson} = -.027$; $R^2 = .001$; $p > 0.10$ (2-tailed test)).

Before presenting the results of the third correlation analysis, let me add a qualitative note to these quantitative findings. As pointed out previously, legislation is very demanding with regard to a drug's purity standards. Whenever a pharmaceutical company seeks to register a new product, it must document that all its ingredients are adequately pure. To this end, a firm must also demonstrate that its suppliers, and the ingredients they deliver, comply with the so-called 'GMP' (General Manufacturing Praxis) standards. These legal requirements make it both difficult and costly for any pharmaceutical firm to change suppliers – irrespective of its competitive strategy. The reason for this is that any change requires an audit of the new suppliers and, sometimes, even the explicit approval on the part of the responsible authorities. The costs related to these administrative procedures mean that pharmaceutical firms usually seek long-lasting collaborations with their suppliers. This, in turn, seems to be the reason why, overall, no significant correlation can be seen between a firm's competitive strategy and the period for which it collaborates with its suppliers.

Interestingly, though, the duration of collaboration does not seem to influence the quality of supplier-producer relations. In line with table 3.7., the third correlation analysis shows that firms which pursue a DQP strategy entertain more collaborative relationships with their suppliers than firms pursing an LCP strategy ($R_{Pearson} = .413$; $R^2 = .170$; $p < 0.05$ (2-tailed test)). This outcome seems to support the initial hypothesis that Diversified Quality Producers use

coordinated standards as a means to foster trust-based relations with their suppliers (see Hall and Soskice 2001a: 26-27; Casper 2001: 399-400; 406-407; Teubner 2001: 433), whereas Low Cost Producers increase price competition among suppliers (see Tate 2001: 454).

To assess the *relative* importance of this VoC argument, it is useful to cross-check its explanatory strength with its strongest rival explanation. In section 3.3.1. we found a firm's size to be an important determinant of a company's propensity to collaborate *with other firms and research organisations* when elaborating new standards. Accordingly, company-size might also determine the quality of collaboration between a firm and its *suppliers*. The reason is that large firms tend to have more bargaining power over their suppliers than small firms. Accordingly, the former find it easier to dictate prices which, in turn, may lead to strained supplier-producer relations. This reasoning suggests the following rival hypothesis: the larger a producer, the stronger its bargaining power towards its suppliers, the more strained their relationship.

So, let us test whether a firm's competitive strategy or its size is a better explanation for the quality of supplier-producer relations. To this end, I carried out three simple linear regression analyses. In the first analysis, I assessed the individual impact of *competitive strategy* (using a DQP strategy as proxy) on the *quality of supplier-producer relations*. Similarly, the second analysis tested the single impact of *firm-size* (measured in number of employees). In analysis 3, I determined the relative explanatory power of the two variables by regressing them jointly on the *quality of supplier-producer relations*. Since the aim is to seek to assess whether the quality of relationships varies between Diversified Quality Producers and Low Cost Producers, I excluded all Radical Product Innovators from the analyses. Table 3.8. provides an overview of the results.

Table 3.8: How a *DQP Strategy* and *Firm-Size* impact on the *Quality of Supplier-Producer Relations*
(Results of Simple Linear Regression Analyses: Standardised Beta)

Analysis 1 (DQP → Supplier-Producer Relations)	**Analysis 2** (NbEees → Supplier-Producer Relations)	**Analysis 3** (DQP, NbEees → Supplier-Producer Relations)
.413***	---	.386***
---	.225*	.160
38	38	38
.170	.051	.195

Significance levels: * < 0.10 ** < 0.05 *** < 0.01 (1-tailed test)

Overall, table 3.8. provides empirical support for the hypothesis that Diversified Quality Producers use coordinated standards in a cooperative way with their suppliers (see Hall and Soskice 2001a: 26-27; Casper 2001: 399-400; 406-407; Teubner 2001: 433), whereas Low Cost Producers use them in a formal way (see Tate 2001: 454). Accordingly, analysis 1 repeats the strong correlation already discovered between a firm's competitive strategy and its relationships with suppliers. While a firm's size qualifies as a significant predictor of supplier-producer relations in analysis 2, it should be noted that the correlation is positive. Contrary to our initial predictions, this indicates that larger firms entertain more collaborative relations with their suppliers than smaller firms. This finding does not only contradict our hypothesis; from a statistical point of view, it is also fairly weak. Firm-size constitutes such a weak explanation for the quality of supplier-producer relations that competitive strategy qualifies as the only significant predictor in analysis 3. This outcome provides empirical support for the hypotheses we derived from the VoC literature: Diversified Quality Producers do indeed tend to use coordinated standards as a means to foster trust-based relations with their suppliers (see Hall and Soskice 2001a: 26-27; Casper 2001: 399-400; 406-407; Teubner 2001: 433). Low Cost Producers, on the other hand, seem to employ coordinated standards with the aim of increasing price competition among suppliers (see Tate 2001: 454).

Before summarising the findings of section 3.3.3., I wish to point out that the previous quantitative findings are supported by several qualitative observations made when carrying out interviews. When I asked my interview partners why their firm (did not) change(d) its suppliers frequently, interviewees from Diversified Quality Producers often considered quality (resulting from collaborative relationships with suppliers) as more important than low purchase prices (being the result of tough price negotiations). As a German DQP-interviewee put it: "Wir sind kein Generika-Hersteller, der die ganze Zeit auf den Preis schauen muss!" (We are not a generics firm that constantly has to be concerned about prices). Similarly, an interviewee from a British Diversified Quality Producer described how close collaboration with one supplier made it possible to improve the quality of delivered ingredients: regular analysis of the deliveries' purity patterns had shown that the respective supplier occasionally provided ingredients of a (still sufficient, but) inferior quality. Due to their close collaboration, the two companies combined their know-how and discovered an occasional but systematic flaw in the supplier's manufacturing process. Had the latter not been eliminated, this flaw would – in the long run – have led to the production of ingredients of insufficient quality.

In contrast to their DQP-counterparts, interviewees from Low Cost Producers regularly stressed the importance of obtaining low purchase prices – *inter alia* by (threatening to)

change(ing) suppliers. I argued above that stringent legal requirements make it difficult for pharmaceutical producers to change suppliers. Yet it is not impossible to do so. Accordingly, an LCP-interviewee pointed out that his company regularly weighs the costs of supplier change against the savings resulting from less expensive pharmaceutical ingredients: "Wir müssen da jedesmal ganz genau rechnen." (Every time we consider a change, we need to make meticulous calculations.). Interestingly, the possibility to change suppliers seems to give threats of Low Cost Producers the necessary credibility in price negotiations.

In sum, what have we learned about how different competitive strategies translate into different supplier-producer relations? In a word, we found empirical support for the hypothesis that Diversified Quality Producers use coordinated standards for developing collaborative relationships with their suppliers (see Tate 2001: 454), while (Hall and Soskice 2001a: 26-27; Casper 2001: 399-400; 406-407; Teubner 2001: 433)Low Cost Producers tend to use coordinated standards with the aim of furthering price competition among suppliers (see Tate 2001: 454). These findings do not speak directly to the *solution* of the initially described hold-up problem because the nature of the standards employed is already defined: they are coordinated. Nevertheless, it is interesting to note that Diversified Quality Producers use these standards to more cooperative ends, whereas Low Cost Producers employ them as a competitive means.

3.3.4. Concluding Interpretation

To conclude, what do the previous findings teach us about the link between standards and competitive strategies? Shall we reject or accept our initial hypotheses (see section 3.2.)? We have seen that the answer to this question differs for *innovative firms* on the one hand, and for *non-innovative companies* on the other. Regarding the standardisation behaviour of ***non-innovative Low Cost Producers***, we found empirical support for our initial hypotheses regarding both the use and elaboration of standards. In trying to abstain from *using* competitive standards whenever possible, Low Cost Producers employ almost exclusively coordinated standards. In so doing, they use coordinated standards as a means to increase price competition among suppliers. This, in turn, verifies the hypothesis we derived from the VoC literature on how Low Cost Producers make use of coordinated standards (see Tate 2001: 454). Similarly, we found empirical support for the hypothesis that pursuing an LCP strategy makes firms abstain from *elaborating* competitive and coordinated standards alike (see Tate 2001: 467; 446; Büthe and Witte 2004: 12). In a word, Low Cost Producers circumvent the hold-up problem related to the elaboration of standards by free-riding both competitive and coordinated standardisation processes.

That said, we should remember that the VoC scholars are not explicitly concerned with the standardisation behaviour of *Low Cost Producers*. Instead, it is their central claim that *radically* innovative firms differ in their standardisation policies from *incrementally* innovative companies (Hall and Soskice 2001a: 26-27; 30-31; 39-41; Tate 2001: 445-446; 468; Casper 2001: 404-405; 406-407; Teubner 2001: 433-435). However, our analyses did not provide empirical support for this idea. Instead, we found that both Radical Product Innovators and Diversified Quality Producers use and elaborate *coordinated standards*. In that, we also saw that Diversified Quality Producers do *not* elaborate more coordinated standards than Radical Product Innovators in order to 'weed out technically inferior outcomes' (Tate 2001: 446). Instead, those firms engaged in DQP are simply larger, and have the human resources necessary for participating in coordinated standardisation. Similarly, we saw that both Radical Product Innovators and Diversified Quality Producers use and elaborate *competitive standards*. In line with our finding on coordinated standards, we found the reasoning of the VoC literature to be wrong: Radical Product Innovators do not rely more on competitive standards compared to Diversified Quality Producers in order to protect their innovations from imitation (see Casper 2001: 405; Tate 2001: 445; 468; Hall and Soskice 2001a: 31). Instead, we found that the propensity to elaborate and use competitive standards is determined by the value-chain focus of a firm's competitive strategy. In sum, we did not find empirical support for the argument that RPIs show more competitive standardisation behaviour, whereas DQPs tend to adopt cooperative standardisation approaches (Hall and Soskice 2001a: 26-27; 30-31; 39-41; Tate 2001: 445-446; 468; Casper 2001: 404-405; 406-407; Teubner 2001: 433-435).

If anything, we found the opposite to be true. Let us recall that Diversified Quality Producers tend to use coordinated standards as a source of incremental innovation in a rather secret way: unlike radically innovative firms, incrementally innovative companies develop a part of their competitive pharmaceutical ingredients by improving already existing Pharmacopoeia standards and registering the latter with the responsible approving authority. As a result, approving authorities will thenceforward require all pharmaceutical firms wanting to use the Pharmacopoeia standard in question to conform to this new (quality-) standard. Yet such incremental innovations are often not patent-protected. Consequently, other firms meet with difficulties in understanding how the respective improvement has been achieved, because registration documents are not accessible. The standardisation behaviour of DQPs is thus less transparent than the standardisation praxis of RPIs, which elaborate radically new standards on a contractual basis with other firms. This finding can be interpreted to the effect that Diversified

Quality Producers pursue a more competitive standardisation policy than Radical Product Innovators.

3.4. Testing the Hypotheses II: Do(es) specific Standard(i)s(ation) require specific Institutions?

3.4.1. On the Causal Links between Standards and Competitive Strategy

The previous analyses revealed that competitive strategies and (the elaboration/use of different types of) standards are strongly interrelated. More precisely, empirical evidence has shown that a specific strategy *entails* specific standardisation behaviour: Low Cost Producers do not elaborate standards. They merely use coordinated standards to increase price competition among their suppliers. Diversified Quality Producers elaborate and use both coordinated and competitive standards. While they use coordinated standards to foster collaborative relationships with their suppliers, they elaborate competitive standards in a more secret way than Radial Product Innovators. The latter, in turn, focus on the elaboration of competitive standards on a contractual basis with other firms, but also use coordinated standards. In sum, all the analyses carried out have assessed the absolute and relative explanatory power *of* competitive strategy *for* standard(i)s(ation).

Importantly, though, we have *not* tested whether different types of standards are necessary input factors *for* the pursuit of a certain strategy. That is, we have not assessed the explanatory power *of* standard(i)s(ation) *for* competitive strategy! This is interesting to the extent that VoC scholars claim different standard(i)s(ation) facilitate different strategies (see Hall and Soskice 2001a: 26-27; 39-41; Tate 2001: 446; Casper 2001: 398-400; Teubner 2001: 433). To cite just one example, Hall and Soskice argue that 'German institutions support forms of relational contracting and technology transfer (...) [which] encourage corporate strategies that focus on product differentiation and niche production.' (Hall and Soskice 2001a: 26-27). However, the *reasons* provided by the VoC scholars suggest the *opposite* causal relationship, i.e. that specific competitive strategies determine a firm's standardisation behaviour (see Tate 2001: 445; Casper 2001: 404-407).

So, let us test whether specific standard(i)s(ation) translate(s) into the pursuit of specific competitive strategies, or vice-versa. To this end, it is instructive to determine the *relative* explanatory strengths of different standard types for competitive strategies. While such quantitative assessments do not tell us anything about causal mechanisms, they show whether standards constitute a better explanation for a firm's strategy than any rival explanation. If we

find this to be the case, we can deduce that standards constitute a necessary input factor to the extent that firms rely on them substantially more than on any other factor in order to pursue their chosen strategy. But should the *rival factor* turn out to be a better explanation of competitive strategy, we can conclude that a firm's standardisation behaviour does not constitute a necessary input factor, resulting instead from the pursuit of a competitive strategy.

In chapter 2 (section 2.3.2.), we found that a *firm's age* constitutes the strongest rival explanation for the pursuit of a particular competitive strategy. The reason for this is that radical innovation often makes existing products obsolete. Hence, incumbent firms have little interest in pursuing a strategy which accelerates the decline of their own products (Utterback 1994: 160-165). A young firm-age thus seems to facilitate an RPI strategy as young companies usually have few or no product(s) which would become obsolete were a radically new innovation to be made. In line with this reasoning, a strong and statistically significant relationship can indeed be observed between a firm's age and its competitive strategy ($R_{Pearson} = .302$; $R^2 = .091$; $p < 0.05$ (2-tailed test)). But, is the impact of age on strategy stronger than the impact of standards?

To shed light on this question, I carried out several multi-nominal and binary logistic regression analyses. In each analysis, I assessed the explanatory power of *firm-age* in combination with one *standard-variable* for *competitive strategy*. More precisely, I jointly regressed firm-age and the three *standard-elaboration* variables (see section 3.3.1.) on competitive strategy in a first set of analyses[77]. In a second set of analyses, I tested the extent to which the *use of different standards* (see section 3.3.2.) explains a firm's strategy better than its age. Finally, in a last set of correlation analyses, I assessed whether a company's age or its *supplier-producer relations* (see section 3.3.3.) are a better explanation of its pursued strategy[78].

In order not to annoy the patient reader with reproductions of quantitative analyses which all carry the same message, I will confine myself to the following summary. Interestingly, the results of all but three analyses agree in one central point: a firm's age not only constitutes the better, but also the only significant explanation of competitive strategy. Compared to firm-age, the elaboration and use of diverse standards is an explanation so weak that the respective standard(isation)-variable does not qualify as a significant predictor of competitive strategy ($p > .10$). The only exception to this rule is constituted by three analyses. Accordingly, we find (1) the use of competitive standards, (2) the use of coordinated standards, and (3) collaborative supplier-producer relations to be of significant importance for the pursuit of (1) Radical Product

[77] Since Low Cost Producers elaborate neither competitive nor coordinated standards, I had to exclude them from this first set of analyses.

[78] In line with section 3.3.3., I excluded Radical Product Innovators from these analyses because we did not derive any hypotheses on how they use standards so as to foster specific supplier-producer relations.

Innovations and, respectively, of (2,3) Diversified Quality Production. Importantly, though, a firm's age qualifies as an equally significant explanation of competitive strategy in all three analyses. Thereby, the explanatory power of firm-age, and of the respective standard are so similar that both variables are retained as significant predictors in (different steps of) the same analysis, even if a stepwise forward method is employed. But in none of the three analyses does the standard-variable emerge as the significantly stronger explanation of competitive strategy than firm-age!

These results unanimously indicate that standards do not constitute a necessary input factor for the pursuit of a certain strategy because a firm's age is more or, at least, equally facilitative to a firm's strategy. Consequently, a specific standardisation behaviour does not *facilitate* a specific competitive strategy. Instead, it is a *result* of the latter! This finding is particularly interesting to the extent that it contrasts with the overall findings of our finance analyses (see chapter 2). Remember that we found externally provided finance in general, and shareholder capital in particular, to be of decisive importance for a firm's competitive strategy. The reason for this is that shareholders (only provide money if they can) make sure that a firm pursues the strategy which is in line with their risk-return preferences. In so doing, shareholders exert notable *external* pressure on a company's management which, in turn, decisively facilitates the pursuit of a specific strategy (see section 2.4.2.).

Yet this seems to be different for standards. While producers definitely need to agree with their suppliers on the type of standards they wish to use, suppliers do not seem to be able to exert any pressure that would facilitate the pursuit of a specific strategy. The reason for this seems to be that pharmaceutical firms can free-ride the *coordinated* standardisation system, presumably because the latter is highly international (see section 3.4.2.). Furthermore, producers can and do elaborate *competitive* standards on their own. Overall this means that, contrary to (individual) financiers, individual suppliers have a more limited influence on the competitive strategies of processors. Therefore, coordinated and competitive standard(i)s(ation) do(es) not promote competitive strategies, but vice-versa.

3.4.2. On the Importance of National Institutions

Given that we find a firm's standardisation approach to be a function of its competitive strategy but not a necessary input factor, how do institutions fit into the picture? Remember our finding of chapter 2 that national pension and insurance systems have a notable impact on the provision of institutional shareholder capital. Bearing this in mind, it is useful to remember that the VoC literature argues national antitrust regulations to facilitate the provision of specific

standard types. To cite one of the most explicit examples, Hall and Soskice claim that 'German institutions support forms of relational contracting and technology transfer (...) [which] encourage corporate strategies that focus on product differentiation and niche production.' (Hall and Soskice 2001a: 26-27). So, to what extent are institutions important for the pursuit of specific competitive strategies in that they facilitate the provision of specific standards (Tate 2001: 443-446; Hall and Soskice 2001a: 26-27; 30-31; 39-41; see also Teubner 2001: 433-435; Casper 2001: 404-407)? To answer this question in a word: they are not! Since a firm's competitive strategy determines its standardisation policy, not vice-versa, the extent to which antitrust regulation provides specific standards has no impact on the pursuit of a specific strategy.

That said, it is nevertheless interesting to apply the insights we gained from studying (inter)national standardisation processes in order to try and qualify the VoC arguments on the importance of national institutions. To this end, it is most instructive to delve into the argument on coordinated standardisation processes. Remember that one of the central VoC claims is that firms in countries with a common-law tradition find it difficult to elaborate coordinated standards because rigorous antitrust legislation and an open, case-based approach towards product liability discourage large-scale firm collaboration (Tate 2001: 443-446; see also Hall and Soskice 2001a: 26-27; 30-31; Teubner 2001: 433-435). If this reasoning holds true, firms in common-law countries should find it inherently difficult – if not impossible – to elaborate coordinated standards. But neither quantitative nor qualitative evidence supports this idea. As I pointed out in the introduction to section 3.3., no country-specific variations can be observed regarding the extent to which firms in different economies elaborate and use specific standards. This is also true for the extent to which British companies participate in the elaboration of coordinated (Pharmacopoeia) monographs: they are just as active as their counterparts in economies with a code-based law tradition.

What does the ease with which firms in common-law countries elaborate coordinated standards tell us about the claims of the VoC scholars (Tate 2001: 443-446; see also Hall and Soskice 2001a: 26-27; 30-31; Teubner 2001: 433-435)? In essence, it teaches us that their arguments suffer from two flaws: firstly, in line with chapter 2, we find that the VoC scholars tend to overestimate the stringency of national institutions. Neither allegedly rigorous antitrust legislation, nor a case-based approach towards product liability (see Tate 2001: 443-444; Teubner 2001: 433-435) discourages British companies from participating in the elaboration of coordinated (Pharmacopoeia) monographs. The reason for this seems to be grounded in our finding of section 3.3.1.: the extent to which firms participate in coordinated standardisation is, simply, a function of their human resources levels, not of their country's institutional framework.

Indeed, for many years the German Kartellamt was more restrictive in accepting inter-firm collaboration than its British counterpart (see Welteke 1976, section D). This speaks against the importance which Tate, Teubner, as well as Hall and Soskice attach to national institutions in general, and to antitrust regulation in particular (Tate 2001: 443-446; see also Hall and Soskice 2001a: 26-27; 30-31; Teubner 2001: 433-435).

Secondly, we see that the VoC contributors underestimate the international dimension of firms' activities. Today, the coordinated elaboration of new pharmaceutical standards takes place most importantly at a supranational, namely the European level. Standardisation at the national level is far less important than is assumed by the VoC scholars (Hall and Soskice 2001a; Tate 2001; Teubner 2001; Casper 2001). Furthermore, firms can free-ride the coordinated standardisation system both at the European and the national level: while several disadvantages arise from not participating in coordinated standardisation, a company can simply use coordinated standards developed by others.

Overall, these insights entail the same conclusion as reached in chapter 2. Given that institutions do not constrain firms to elaborate coordinated standards in line with national antitrust regulation, entrepreneurs are more than mere institution-takers. On the contrary, we found that – depending on the requirements of their firm's strategy – entrepreneurs deliberately collaborate at the (inter)national level, or free-ride coordinated standardisation processes. Thus, entrepreneurs are not only less constrained by national institutions than assumed by the VoC scholars (Hall and Soskice 2001a; Tate 2001; Teubner 2001; Casper 2001); they are also more inventive. I therefore conclude that a Schumpeterian perception of entrepreneurs as independent and innovative actors is most instructive to understand how firms gain international competitiveness (see e.g. Schumpeter 1934, chapter 4; Schumpeter 1942: 81-106).

3.5. Concluding Interpretation

What have we learned from studying the link between institutions, the provision of standards, and their importance for different competitive strategies? To begin with, we found that specific standards do *not* constitute a necessary input factor for the pursuit of a specific strategy. That is, standards do not facilitate a firm's competitive strategy. Instead, we observed the opposite causal relationship, in that each strategy determines a firm's standardisation policy. More precisely, we found that the standardisation behaviour of firms differs most notably between non-innovative Low Cost Producers on the one hand, and (radically and incrementally) innovative firms on the other. Accordingly, Low Cost Producers neither elaborate nor use competitive standards. Similarly, they do not elaborate coordinated standards. Instead, they free-

ride the coordinated standardisation system, and use the standards developed by others to the end of increasing price competition among suppliers. These findings confirm the hypotheses we derived from the VoC contributors (see Tate 2001: 454; 467; 446; see also Büthe and Witte 2004: 12).

Importantly, though, the central argument of the VoC literature does *not* concern *non-innovative Low Cost Producers*. But the VoC scholars argue that *radically* innovative firms organise their activities in a more competitive and less coordinated way than incrementally innovative firms (Hall and Soskice 2001a: 26-27; 30-31; 39-41; Tate 2001: 445-446; 468; Casper 2001: 404-405; 406-407; Teubner 2001: 433-435). However, our analyses did not provide empirical support for this idea. We found instead that Diversified Quality Producers compete in a less transparent way as they show a tendency to elaborate competitive standards on their own, and to use coordinated Pharmacopoeia standards as a source of incremental innovation not available to other firms. These insights can be interpreted to the effect that Diversified Quality Producers show a more competitive standardisation behaviour than Radical Product Innovators, which tend to elaborate standards on a contractual basis with other firms. This, in turn, contradicts the hypothesis of the VoC scholars that Diversified Quality Producers compete in a more cooperative way than Radical Product Innovators (Hall and Soskice 2001a: 26-27; 30-31; 39-41; Tate 2001: 445-446; 468; Casper 2001: 404-405; 406-407; Teubner 2001: 433-435).

The finding on the causal relationship between a firm's strategy and its standardisation behaviour is particularly instructive in two respects. Firstly, it sheds light on the arguments of the broader competitiveness literature. Remember that the latter agreed on the importance of specific supplier-producer relations for a company's competitiveness (Hall and Soskice 2001a: 7; 39-41; Tate 2001; Lundvall 1992b: 13-14; chapter 3; Andersen 1992: 69; 82-91; Gelsing 1992; Hollingsworth 2000: 628; Porter 1990: 71-72; 100-107). However, the literature was not clear about causal mechanisms or causal directions (Lundvall 1992c: 57-58; Andersen 1992: 82-84; see also Gelsing 1992: 119; Hollingsworth 2000: 628; Porter 1990: 103). Are specific types of supplier-producer relations 'necessary prerequisites for product'-market strategies (Lundvall 1992c: 54), or do the former 'develop' as a result of the latter (Lundvall 1992c: 57)? We can now answer this question: specific supplier-producer relations develop *as a result of* a firm's competitive strategy, *depending on* the extent to which its *value-chain focus* renders it preferable to use and elaborate specific standards.

Secondly, the finding on the causal relationship between a firm's competitive strategy and its standardisation policy also sheds light on the importance of standards as allegedly indispensable input factors. Remember that I decided to focus on how finance, standards, and

labour qualifications impact on a firm's strategy, since the competitiveness literature argues these three input factors to be decisive for the pursuit of any competitive strategy (see in particular Hall and Soskice 2001a: 6-7; see also Lundvall 1992a: 13-15; Andersen 1992: 68-69; Patel and Pavitt 1994: 91-92; Hollingsworth 2000: 627-628; 632; Porter 1990: 20). The reasoning behind this is that these factors cannot be secured by a firm working alone but only in collaboration with other economic actors – following the solution of a coordination problem (Hall and Soskice 2001a: 6). Interestingly, this reasoning seems to be erroneous with regard to standards. Given that we find standards to *result* from competitive strategy, the former do *not constitute a necessary input factor* for the pursuit of any strategy. Consequently, it may have been sufficient to limit my analyses to two input factors: finance and labour skills.

Interestingly, the analyses contained in the present chapter lead to the same conclusions reached in chapter 2. Remember the ease with which firms in common-law countries elaborate coordinated standards both at the national and, even more importantly, at the European level. This finding indicates that the arguments of the VoC literature (Tate 2001: 443-446; see also Hall and Soskice 2001a: 26-27; 30-31; Teubner 2001: 433-435) are grounded on two central misconceptions: on the one hand, the VoC scholars overestimate the stringency of national institutions. A country's legal tradition in general, and its antitrust regulation in particular, determine neither the type of standards which a firm elaborates, nor the level at which standardisation takes place. On the other hand, the VoC scholars underestimate the inventiveness of entrepreneurs. We have seen that entrepreneurs elaborate competitive standards with other firms, or on their own; that they make the resulting knowledge accessible to others, or keep it to themselves; and that they collaborate and compete at both the national and international level – *depending on the requirements of their competitive strategy*! I therefore argue that a Schumpeterian perception of entrepreneurs as independent and inventive creators (see e.g. Schumpeter 1934, chapter 4; Schumpeter 1942: 81-106) is more instructive to explain (inter)national firm competitiveness than the VoC understanding of entrepreneurs as mere institution-takers (see e.g. Tate 2001: 443-446; Hall and Soskice 2001a: 26-27; 30-31; 39-41; Teubner 2001: 433-435).

4. On the Link between Institutions, the Provision of Labour Qualifications, and Their Impact on Competitive Strategies*

4.1. Entrepreneurs: Constrained Institution-Takers or Voluntaristic Innovators?

It is difficult to imagine how a firm could operate without a labour force. Accordingly, the competitiveness literature concurs *that* 'labour' constitutes a necessary input factor for the pursuit of any competitive strategy (Hall and Soskice 2001a: 24-27; 29-30; Estevez-Abe et al. 2001; Porter 1990: 74-76; Hollingsworth 2000: 627-629; Freeman 1992; Patel and Pavitt 1994; Heckscher 1919; Ohlin 1933; Sinn 2005). Yet the literature is also concerned with the question of whether certain *types of labour qualifications* are required for the pursuit of certain competitive strategies. In that, different strands of the literature focus on diverse groups of employees. While the strategic management literature (Porter 1990: 73-75; Porter 1985: 121-122; 127) and the literature on 'varieties of capitalism' (Estevez-Abe et al. 2001; Hall and Soskice 2001a: 24-27; 29-30; 39-44) propose arguments about the *overall labour force* of a company, the innovation literature tends to focus on the knowledge base of a firm's *scientists* (Hollingsworth 2000: 627-629; Hollingsworth and Hollingsworth 2000: 223-224; Freeman 1992: 170-171; Nelson 1993: 511; Patel and Pavitt 1994: 90-92). Neoclassical trade theory (Heckscher 1919: 57; 55; Ohlin 1933: 7; 50-54) and neoliberal economic theory (Sinn 2005), in turn, study how labour costs determine a firm's competitiveness in general, and its competitive strategy in particular.

Despite their different foci, the aforementioned strands of the competitiveness literature agree in two central claims. Firstly, different types of labour qualifications are said to facilitate different competitive strategies (Estevez-Abe et al. 2001: 174-176; Hall and Soskice 2001a: 39-44; Porter 1985: 121-122; 127; Hollingsworth 2000: 627-629; Hollingsworth and Hollingsworth 2000: 223-224; Freeman 1992: 170-171; 182; Ohlin 1933: 7; 50-51; Sinn 2005: 18-19). Secondly, the literature agrees that national institutions differ in the extent to which they provide a labour force with certain types of qualifications (Estevez-Abe et al. 2001: 145; 150-155; Hall and Soskice 2001a: 24-27; 29-30; Porter 1990: 73-75; Hollingsworth 2000: 627-629; Freeman

* My special thanks go to Sibylle Gaisser for providing me with precious documentation, and for giving me access to labour force data on German pharmaceutical firms. I also wish to thank her and Michael Nusser for their in-depth feedback on my questionnaire. Furthermore, I am grateful to Paolo Barbanti, Lorenzo Chiriatti and Leonardo Frezza who so patiently advised me about labour-market regulation in Italy. Furthermore, I wish to thank Marco Caremi, Giuseppe Giardina, Zoe Halliday, Udo Klomann, Luigi Orsenigo, Thomas Reiss, Alvise Sagramoso, Gaia Sorrone, Stefano Svetoni, Itala Turco, and Leonardo Vingiani for their support in establishing contacts with interview partners. Finally, I am grateful to the numerous interviewees who did not merely answer my questions, but who also

1992: 170-171; 182; Dalum, Johnson, and Lundvall 1992: 303; Nelson 1993: 511; Patel and Pavitt 1994: 90-92; Ohlin 1933: 7; 52-54). More precisely, flexible labour markets are said to provide employees and scientists with rather general qualifications. Rigid labour markets, in contrast, are said to allow employees and scientists to acquire highly specific qualifications. Taken together, these two claims lead to the central argument of the competitiveness literature that firms in the same labour-market economy are provided with the same type of skills which, in turn, makes firms specialise in the pursuit of the same competitive strategy (see in particular Estevez-Abe et al. 2001; Hall and Soskice 2001a: 36-44; Porter 1990; Hollingsworth 2000: 627-629; Freeman 1992: 170-171; 182; Heckscher 1919: 57; 55; Ohlin 1933: 7; 50-54; Sinn 2005).

The introductory chapter has proven this argument to be wrong: pharmaceutical firms in the UK, Germany and Italy alike pursue strategies of Radical Product Innovation (henceforth RPI), of Diversified Quality Production (henceforth DQP), and of Low Cost Production (henceforth LCP)[79]. The slight strategy-specialisation patterns observed turned out to be statistically insignificant (see chapter 1). This finding left us with the following puzzle to be explained: How can firms in the same economy pursue different competitive strategies despite the fact that institutions provide just one set of input factors, which presumably facilitate just one competitive strategy? To shed light on this question, my research studies the link between *institutions*[80], the extent to which they provide certain input factors (namely *finance*, *component standards*, and *labour qualifications*[81]), and the impact of the latter on *competitive strategies*.

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provided me with precious background information, literature and documentation about the importance of labour qualifications for competitive strategies.

[79] I took the decision to distinguish between *three* competitive strategies on the grounds of deductive reasoning, and an in-depth review of the competitiveness literature (see e.g. Ohlin 1933: 7; Sinn 2005: 18-19; Lundvall 1992b: 11-12; 57-59; Freeman 1992: 182; Porter 1990: 10; 37; Hall and Soskice 2001a: 38-39; Estevez-Abe et al. 2001: 148-149; 174-175; Casper 2001: 398-400). My assumption that a distinction between three strategies is both sufficient and necessary was empirically confirmed *ex post* by the fact that I could attribute one strategy to each firm of the sample (see chapter 1; section 1.3.2.). Furthermore, operational differences between the three groups of firms turned out to be statistically significant in that each strategy actually requires specific input factors. Thus, the decision to distinguish between three strategies is justifiable from both a theoretical and an empirical perspective.

[80] In line with Steeck and Thelen (2005: 9-16), I understand institutions as 'formalized rules that may be enforced by calling upon a third party' (Streeck and Thelen 2005: 10).

[81] As pointed out previously (see chapter 1: section 1.4.), a large number of input factors exist which could potentially facilitate the pursuit of a competitive strategy (see e.g. Porter 1985: 85-86; 122; 343-350). To limit the scope of my research endeavour, I decided to focus on those three factors which the competitiveness literature sees as decisive for the success of any competitive strategy, namely (1) *financial means*, (2) new *component standards*, and (3) *labour qualifications*. The reason for which these factors are said to be decisive is that a firm cannot secure them on its own. Instead, they are only provided following the successful solution of a coordination problem between a firm and other economic actors (see in particular Hall and Soskice 2001a: 6-7; see also Lundvall 1992a: 13-15; Andersen 1992: 68-69; Patel and Pavitt 1994: 91-92; Hollingsworth 2000: 627-628; 632; Porter 1990: 20). The provision of *labour qualifications*, around which the analyses of this chapter are centred, depends on the successful solution of a *free-riding problem* on the one hand, and of a *hold-up problem* on the other. I will elaborate on these coordination problems in sections 4.2.1. and 4.3.1. in order to illustrate how diverse institutional solutions provide different types of labour qualifications.

Having studied the importance of finance (see chapter 2) and standards (see chapter 3), I will focus in the present chapter on the impact of the third input factor: labour qualifications[82].

In aiming to reveal how firms in different labour-market economies are able to pursue the same variety of strategies, I test the two sets of hypotheses proposed in the competitiveness literature. Accordingly, I proceed in two steps. In order to understand whether and, if so, which labour qualifications are of significant importance for competitive strategies, I ask firstly:

1. is it true that an RPI, a DQP and, respectively, an LCP strategy requires certain types of labour qualifications (Estevez-Abe et al. 2001: 174-176; Hall and Soskice 2001a: 39-44; Porter 1985: 121-122; 127; Hollingsworth 2000: 627-629; Hollingsworth and Hollingsworth 2000: 223-224; Freeman 1992: 170-171; 182; Ohlin 1933: 7; 50-51; Sinn 2005: 18-19)? Should this turn out to be the case, the second step consists in understanding the importance of labour-market institutions as providers of these qualifications. I therefore continue my analyses by asking:
2. is it true that each required qualification is only provided by country-specific labour-market institutions (Estevez-Abe et al. 2001: 145; 150-155; Hall and Soskice 2001a: 24-27; 29-30; Porter 1990: 73-75; Hollingsworth 2000: 627-629; Freeman 1992: 170-171; 182; Dalum et al. 1992: 303; Nelson 1993: 511; Patel and Pavitt 1994: 90-92; Ohlin 1933: 7; 52-54)?

Overall, the answers to these questions are in line with the findings of chapters 2 and 3. Contrary to chapter 3, but not to chapter 2, the present chapter reveals that certain qualifications constitute a necessary input factor. More precisely, Radical Product Innovation requires employees with field-specific skills and scientists with heterogeneous knowledge. Diversified Quality Production, in turn, necessitates a workforce with firm-specific skills as well as scientists with homogeneous knowledge. Low Cost Producers, in contrast, require neither employees with specific skill profiles nor scientists with particular knowledge diversity. Accordingly, an LCP strategy can be pursued irrespective of the extent to which national institutions provide certain labour qualifications, while this is not the case for either Radical Product Innovators or Diversified Quality Producers. In that, I find both national labour-market institutions and research systems to facilitate the provision of those labour qualifications which are required for an RPI strategy on the one hand, and a DQP strategy on the other.

But what do these findings teach us about the strategy-specialisation argument of the competitiveness literature? In line with chapter 2, I find that the literature falls short in that it grounds its central argument on two fundamental misconceptions. Firstly, it overestimates the

[82] It is interesting to note that *labour qualifications* constitute a particularly comprehensive input factor in that they incorporate many factors which are considered separately in other strands of the competitiveness literature. To give an example, factors like technology-access, marketing-capacities, or knowledge about market-structures ultimately depend on a firm's capacity to secure employees with adequate qualifications.

stringency of *national* institutions (see in particular Estevez-Abe et al. 2001; Hall and Soskice 2001a: 36-44; Porter 1990: 126-130; Hollingsworth 2000: 627-629; Ohlin 1933: 7; 52-54; Sinn 2005: e.g. 68-69; 75-76; 142-143). Whenever firms are not provided with the necessary labour qualifications by national institutions, we find entrepreneurs to circumvent these institutions by *'improvising' on a contractual basis* and by *'importing' skills from abroad.* Hence, entrepreneurs use or develop institutional equivalents in order to secure an adequately skilled labour force. As a corollary, secondly, I find the competitiveness literature to fall short in underestimating the inventiveness of entrepreneurs: entrepreneurs are not mere institution-takers (ibid). On the contrary, we see that they are highly inventive in exploiting existing, and in creating new institutional pathways to gain international competitiveness. I therefore conclude that Schumpeter's perception of entrepreneurs as independent creators (see e.g. Schumpeter 1934, chapter 4; Schumpeter 1942: 81-106) is more instructive for understanding how firms are able to pursue different strategies within the same institutional contexts.

To illustrate these points, the remaining parts of this chapter are organised as follows. Given that different strands of the competitiveness literature focus on different labour-force groups, I test their hypotheses in two separate blocks. In section 4.2., I focus on the hypotheses of the 'varieties of capitalism' (henceforth VoC) literature about the skill types of a firm's ***entire workforce*** (Hall and Soskice 2001a; Estevez-Abe et al. 2001). In so doing, I show that different skill *profiles* constitute a necessary input factor for the pursuit of diverse strategies. Different skill *levels*, by contrast, are *per se* of no importance, because a balance exists between the level of education and labour productivity. Interestingly, these findings also shed light on the arguments of neoclassical trade theory (Heckscher 1919: 57; 55; Ohlin 1933: 7; 50-54) and neoliberal economic theory (Sinn 2005) regarding the importance of labour costs for a firm's competitive strategy. Section 4.2. concludes with an illustration of how entrepreneurs circumvent rigid and, respectively, flexible labour-market institutions in order to secure their required skill profiles. In parallel with section 4.2., section 4.3. presents and tests the hypotheses of the innovation literature on the knowledge base of a firm's ***scientists*** (Hollingsworth 2000; Hollingsworth and Hollingsworth 2000; Lundvall 1992b). In so doing, the section reveals that each competitive strategy actually requires certain scientific knowledge – in addition to specific skill profiles (see section 4.2.). To illustrate how such knowledge is provided in countries with different research systems, section 4.3. concludes by describing the various ways in which entrepreneurs circumvent national institutions. Section 4.4. summarises and interprets the various findings.

4.2. The Hypotheses of the VoC Literature on Skill Levels and Skill Profiles

Contrary to the scarcity of studies on standards (see chapter 3), diverse strands of the competitiveness literature stress that 'in a modern economy, skills are essential for firms to compete in international markets' (Estevez-Abe et al. 2001: 181). In so doing, both the strategic management literature (Porter 1990: 73-75; 126-130; Porter 1985: 121-122; 127) and the VoC literature (Estevez-Abe et al. 2001; Hall and Soskice 2001a: 24-27; 29-30; 39-44; King and Wood 1999: 376) propose arguments about how national institutions provide a firm's *entire workforce* with different skill types which, in turn, are said to be needed for the pursuit of different competitive strategies. It is the aim of this section to test these hypotheses. A further set of hypotheses can be derived from the innovation literature about how institutions provide *scientists* with diverse knowledge, which is said to be required for specific strategies (Hollingsworth 2000: 627-629; Hollingsworth and Hollingsworth 2000: 223-224; Freeman 1992: 170-171; 182). The assessment of the latter hypotheses will be carried out in section 4.3..

That said, let us test the arguments about the skill types of a firm's entire workforce. In so doing, I will focus on the hypotheses proposed in the VoC literature, since the latter are well developed, whereas the hypotheses of the strategic management literature remain at a rather general level. Interestingly, the findings resulting from this assessment also shed light on the importance of *labour costs* for a firm's competitiveness in general, and for its choice of competitive strategy in particular. These findings speak to the central arguments of neoclassical trade theory (Heckscher 1919: 57; 55; Ohlin 1933: 7; 50-54) on the one hand, and neoliberal economic theory (Sinn 2005) on the other (see sections 4.2.2.3. and 4.2.3.3.).

4.2.1. The VoC Hypotheses: How Different Labour-Market Institutions provide Employee Skills for Different Competitive Strategies

As mentioned in the introduction, I decided to limit my analyses to three input factors because the competitiveness literature claims that (1) finance, (2) component standards, and (3) labour qualifications crucially determine the competitive capacities of any firm (see in particular Hall and Soskice 2001a: 6-7; see also Lundvall 1992a: 13-15; Andersen 1992: 68-69; Patel and Pavitt 1994: 91-92; Hollingsworth 2000: 627-628; 632; Porter 1990: 20). The reason for this is that a firm cannot secure these input factors on its own. Instead, their provision depends on the solution of a coordination problem between a company and external economic actors (Hall and Soskice 2001a: 6). With regard to employee skills, a coordination problem arises which the literature describes as the *free-riding problem* related to the professional education and training of

employees (see Hall and Soskice 2001a: 25-26; Estevez-Abe et al. 2001: 145; Culpepper 2001: 278-281; Le Gales and Voelzkow 2001: 4-5). *Employers*, so the argument goes, are not willing to invest in sophisticated training programs if they fear that competitors will free-ride their educational efforts by poaching trained employees without investing in training programs themselves. In a similar vein, *employees* are not interested in acquiring highly specific skills if the risk of being dismissed at short notice is high, since firm-specific skills are often of little use within the context of another firm and are therefore remunerated rather badly by the latter. Thus, whenever employees have to look for a new job, which occurs regularly in flexible labour markets, firm-specific skills are less desirable. In sum, as long as no mechanism exists that assures employers against the risk of poaching, and employees against the risk of dismissal at short notice, they are both reluctant to invest in highly specific skills (see Hall and Soskice 2001a: 29-30; Estevez-Abe et al. 2001: 145).

Several contributors to the VoC literature point out that this free-riding problem can be resolved in two different ways: by long-term oriented labour-market regulation on the one hand, and by flexible labour-market regulation on the other (Hall and Soskice 2001a: 24-26; 29-30; Estevez-Abe et al. 2001: 145; 150-155). If ***labour-market institutions promote long-term employment***, both employers and employees are willing to engage in sophisticated training programs, because they are assured that this investment will pay off. Long job tenures result from wage-bargaining centralisation, powerful works councils, long notice periods, and a stark use of competition clauses. In centralised bargaining systems, wage levels are homogeneous because employees with equivalent skills are paid equivalent wages. Homogenous wage levels assure *employers* that highly skilled workers - once trained - are unlikely to leave their company, as financial incentives are limited. Furthermore, homogeneous wages also assure *employees* 'that they are receiving the highest feasible rates of pay in return for' their commitment to invest in specific skills (Hall and Soskice 2001a: 25). In a similar vein, works councils with authority over layoffs, as well as long notice periods and competition clauses, tie employees to the firm. Since such rigid labour-market institutions make frequent changes of employment disadvantageous, employers are willing to offer sophisticated training which, in turn, provides their workforce with ***high*** and ***firm-specific skills***[83] (Hall and Soskice 2001a: 24-26; see also Estevez-Abe et al. 2001: 150-155).

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[83] In line with Becker (Becker 1975: 26-27), I define *firm-specific skills* as those skills which are useful only within the context of one firm because they are based on the knowledge of how the firm operates. Accordingly, firm-specific training 'increases the future marginal productivity of workers [only] in the firm providing it' (Becker 1975: 19). The ability to use highly sophisticated machines, an in-depth knowledge of the firm's production process, or insights into the preferences of key customers are examples of firm-specific skills.

On the other hand, ***flexible labour-market institutions*** solve the abovementioned free-riding problem in that they deter employers and employees from investing in sophisticated training (Hall and Soskice 2001a: 29-30; see Estevez-Abe et al. 2001: 150-155). Typically, a flexible labour market is characterised by wage-bargaining decentralisation, weak works councils, short notice periods and a limited use of competition clauses. These labour-market institutions have the opposite effect of the abovementioned long-term oriented institutions: they lead to short job tenures as they facilitate hiring and firing at will. Since employers in flexible labour markets are not assured against the risk of poaching, they are unlikely to provide elaborate training programs. Accordingly, the costs of further (secondary and tertiary) education are entirely passed on to potential employees (see Hall and Soskice 2001a: 29-30). Once they have finished primary education, employees therefore have to take a decision. They may decide *not* to continue education but to start working. This decision means they end up with ***low skill levels*** (see King and Wood 1999: 376). Alternatively, potential employees can, of course, decide to engage in secondary or tertiary education so as to acquire further skills. However, the VoC literature stresses that employees in flexible labour markets are unlikely to acquire firm-specific skills because the latter are only useful for, and rewarded adequately by only one firm. So, whenever job tenures are short, employees are better advised to acquire field-specific skills which they can use in the context of different firms[84]. Thus, employees who decide to continue education and training in a flexible labour market gain ***high*** and ***field-specific skills*** (see Hall and Soskice 2001a: 30; Estevez-Abe et al. 2001: 146).

But how are these three types of labour skills related to competitive strategies? In a word, the aforementioned contributors to the VoC literature claim that *high and firm-specific skills* promote *Diversified Quality Production*, whereas *high and field-specific skills* facilitate *Radical Product Innovation* (Hall and Soskice 2001a: 39-41; 44; Estevez-Abe et al. 2001: 174-175). *Low skills*, in turn, are said to favour *Low Cost Production* (Estevez-Abe et al. 2001: 175-176).(see Hall and Soskice 2001a: 44; see also King and Wood 1999: 376) Let us briefly outline the reasons underlying these hypotheses.

Hall and Soskice argue that employees with ***high and firm-specific skills*** are crucial for the success of a DQP strategy (Hall and Soskice 2001a: 39). On the one hand, ***high skill levels*** are

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[84] In line with Becker (Becker 1975: 19-20), I refer to *field-specific skills* as those skills which employees can use within the context of all firms – be they active in the same or another industry – in which a certain business function is required. Hence, 'general training increases the marginal productivity of trainees by exactly the same amount in the firms providing the training as in other firms' (Becker 1975: 26). A marketing manager's ability to carry out a market analysis, the capacity of an assembly-line worker to report dysfunctions in the production process in a systematic way, or the presentation and communication skills of a sales representative constitute examples of field-specific skills.

essential for Diversified Quality Production because workers have to use and maintain sophisticated machines and perform rather complex (assembly-) tasks. *Firm-specific skills*, on the other hand, are crucial for the success of a DQP strategy because an in-depth knowledge of the company, its market, suppliers and customers enables employees to continuously **improve** products and production processes, and to adopt products to the specific needs of customers. Furthermore employees with an in-depth understanding of how a firm operates are able to **work autonomously** and to take on responsibility. They know, for example, how to rectify mistakes occurring during the production process which, in turn, contributes to maintaining a high level of product quality (Hall and Soskice 2001a: 39).

On the other hand, several contributors to the VoC literature claim that ***high and field-specific skills*** facilitate the pursuit of an RPI strategy (Hall and Soskice 2001a: 40-41; Estevez-Abe et al. 2001: 174-175). It is important to note that these scholars are not explicit as to why field-specific *skills* (resulting from flexible labour-market regulation) promote an RPI *strategy*. Instead, they repeatedly point out that flexible labour-market *institutions* directly facilitate an RPI *strategy* because 'companies interested in developing an entirely new product line can hire in personnel with the requisite expertise, knowing they can release them if the project proves unprofitable.' (Hall and Soskice 2001a: 40; see also Estevez-Abe et al. 2001: 174-175). Yet this reasoning allows us to deduce the following line of argument: to come up with entirely new ideas, employees need to be *highly skilled* as they should have an in-depth understanding of how certain technologies or industrial processes work. Furthermore, *field-specific skills* are required for an RPI strategy because employees can adapt more easily to a new environment. To put it differently, employees who have worked within the context of the same firm for a long time may be so used to this environment that they have difficulties in understanding and adapting to an entirely new reality. Accordingly, high and field-specific labour skills arising from frequent changes of employment may further the pursuit of an RPI strategy (see Hall and Soskice 2001a: 40-41; Estevez-Abe et al. 2001: 174-175).

Finally, from various contributions to the VoC literature we may deduce the hypothesis that the successful pursuit of an LCP strategy relies on ***low skilled employees*** because they are comparatively inexpensive (Estevez-Abe et al. 2001: 175-176; see Hall and Soskice 2001a: 44; see also King and Wood 1999: 376). In contrast to Diversified Quality Production, low skill levels do not hamper the success of Low Cost Production. Since low skilled employees are often unable to work autonomously or to assume responsibility, they cannot rectify mistakes occurring during the production process without precise instructions on the part of their superiors. While this hinders the production of high-quality goods, it does not constitute an obstacle to an LCP

strategy in that Low Cost Producers compete on the basis of price rather than quality. Accordingly, low but 'inexpensive' skills facilitate the pursuit of an LCP strategy.

In sum, the VoC literature argues that the pursuit of a DQP strategy requires employees with high and firm-specific skills, whereas the pursuit of an RPI strategy relies on employees with high and field-specific skills. An LCP strategy, by contrast, is said to rely on employees with low skill levels (Hall and Soskice 2001a: 39-41; 44; Estevez-Abe et al. 2001: 174-176; see also King and Wood 1999: 376). Table 4.1. provides a schematic overview of these hypotheses.

Table 4.1.: Hypothetical Relationships between Employee Skills and Competitive Strategies

Input Factor / Production Strategy	Labour Skills		
	Skill Level		
	Low Skills	High Skills	
		Skill Profile	
		firm-specific	field-specific
1. Radical Product Innovation			X
2. Diversified Quality Production		X	
3. Low Cost Production	X		

Source: Own Illustration

4.2.2. Falsifying the VoC Hypotheses on Skill Levels

Having presented the hypotheses of the VoC contributors, I analyse in the remaining parts of section 4.2. whether any empirical evidence exists to support their arguments. To this end, I first test the hypotheses on *skill levels* in section 4.2.2., leaving the assessment of the hypotheses on *skill profiles* to section 4.2.3.. Before beginning these assessments, however, it is useful to make two methodological remarks. Firstly, it should be noted that the following analyses are based on a combination of quantitative and qualitative insights. I obtained the data for the subsequent quantitative analyses from carrying out structured interviews with representatives of pharmaceutical firms[85]. While asking mainly closed questions, I also posed several open questions whose answers provided me with precious qualitative insights[86]. As described in the introduction to section 2.3. (see chapter 2), the overall firm sample contains 110 pharmaceutical

[85] As discussed in chapter 1 (section 1.3.1.) I use the term *pharmaceutical firm* as a generic term for all types of companies which are active in the drug industry, i.e. for biotech-, traditional pharmaceutical-, and generics firms alike.

[86] The questionnaire which I used as a basis for these interviews is reproduced in the appendix.

firms. I was able to carry out 69 interviews which, in turn, equals a coverage rate of roughly 60%. In small firms, I often interviewed senior managers (the CEO or comparable). In large firms, representatives of the Human Resources department were the most adequate interview partners to answer my questions. Importantly, these interviews did not merely provide me with quantitative data. They also offered precious qualitative insights into how different types of labour qualifications impact on competitive strategies. These qualitative insights were crucial for structuring and interpreting the following quantitative analyses.

Secondly, I always tested for country-specific variations. It is important to note that I obtained the results, presented in the remainder of section 4.2., from analysing the overall dataset of 69 pharmaceutical firms. However, in order to cross-check these results, I re-ran all analyses for each country separately. In so doing, I occasionally observed slight country-specific variations in the *absolute* extent to which firms rely on specific skill types. Furthermore, the number of cases per county was sometimes too small to provide statistically significant results. Interestingly, though, I found all country-specific results to be in line with the overall outcome in that specific competitive strategies relied *equally* on specific skill types in *relative terms*. Thus, country-specific analyses do not contradict any of the arguments I present in the following section, based on studies of the overall case sample. That said, let us finally turn to test the VoC hypotheses on the importance of skill levels for competitive strategies.

4.2.2.1. Testing the VoC Hypotheses on Skill Levels

If the hypotheses of the VoC contributors hold true, we should find that Radical Product Innovators and Diversified Quality Producers rely on highly skilled employees (Hall and Soskice 2001a: 39; 40-44; see Estevez-Abe et al. 2001: 174-175), whereas Low Cost Producers employ low skilled labour forces (Estevez-Abe et al. 2001: 175-176; see Hall and Soskice 2001a: 44; King and Wood 1999: 376). To reveal differences in skill levels, I asked Human Resources managers to specify the percentage of employees with primary[87], secondary[88], and tertiary[89] education. Table 4.2. provides an overview of the answers obtained, detailing them by competitive strategy and country.

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[87] As specified in the questionnaire (see appendix: question 2A) 2.1.1.), I defined *employees with primary education* as employees who left education after compulsory school attendance.

[88] As detailed in the questionnaire (see appendix: question 2A) 2.1.1.), I defined *employees with secondary education* as employees who completed education with a certificate in vocational training.

[89] As specified in the questionnaire (see appendix: question 2A) 2.1.1.), I defined *employees with tertiary education* as employees who completed education with a university degree or comparable higher education.

Table 4.2.: Percentage of Employees with 1ary, 2ary and 3ary Education, detailed by Country and Competitive Strategy

Group of Firms	No. of Cases	Primary Education	Secondary Education	Tertiary Education
Average RPIs UK	7	12,2	14,7	73,1
Average DQPs UK	8	29,2	17,8	53,0
Average LCPs UK	4	43,7	25,8	30,5
Overall Average UK (all UK Firms)	19	*26,0*	*18,3*	*55,7*
Average RPIs Germany	6	4,5	23,7	71,8
Average DQPs Germany	11	4,5	59,4	36,1
Average LCPs Germany	9	5,6	62,1	32,3
Overall Average Germany (all German Firms)	26	*4,9*	*52,1*	*43,0*
Average RPIs Italy	7	11,9	31,6	56,5
Average DQPs Italy	10	13,2	37,0	49,8
Average LCPs Italy	4	6,3	40,0	53,7
Overall Average Italy (all Italian Firms)	21	*11,4*	*35,8*	*52,8*
Overall Average RPIs	20	9,8	23,3	66,9
Overall Average DQPs	29	14,3	40,2	45,5
Overall Average LCPs	17	14,7	48,4	36,9
Overall Average (All Firms)	66	*13,0*	*37,2*	*49,8*

Source: Own illustration, evaluating question 2A)2.1.1. (see appendix for questionnaire)

Two particularly noteworthy observations can be made on the basis of table 4.2.. Firstly, country-specific variations can be observed in the *absolute* extent to which firms pursuing a given strategy employ specific skill levels. Interestingly, these variations seem to depend on a country's vocational-training system. In Germany, with its highly sophisticated industry-wide system, firms tend to rely more on employees with secondary education than companies in the UK, where such a system is absent. Vocational-training programs exist in Italy; but they are less deeply embedded in firms than in Germany. As a result, Italian firms rely on employees with secondary education to a medium extent.

Secondly, despite these country-specific variations in *absolute* skill levels, certain levels seem to be *relatively* more important for some strategies than for others. Contrary to the predictions of the VoC scholars, table 4.2. suggests that no pronounced distinction in the use of different skill levels occurs between LCPs and Non-LCPs, but occurs instead between RPIs and Non-RPIs. That is, Radical Product Innovators seem to employ considerably more people with tertiary education than both Diversified Quality Producers and Low Cost Producers. Apart from

using less employees with tertiary education, DQPs and LCPs also pursue a similar employment policy in that they rely on roughly the same amounts of workers with primary and secondary education. Finally, it is interesting to note that people with primary education constitute the least important group of employees, irrespective of a firm's strategy. It almost seems as if Radical Product Innovators, Diversified Quality Producers, and Low Cost Producers try to avoid employing people from this education group. In sum, while differences in the employment of specific skill levels can be observed, these observations do not suggest that Low Cost Producers rely on low skilled employees whereas Radical Product Innovators and Diversified Quality Producers employ high-skilled labour (Estevez-Abe et al. 2001: 174-176; Hall and Soskice 2001a: 39-44).

Nevertheless, let us test the statistical stability of these observations with the aid of quantitative analyses. To this end, the question arises of how to define *low* and *high skill levels*. Are employees only low skilled if they have primary education, or are they also low skilled if they have not received more than secondary education? It should be noted that Hall and Soskice repeatedly point out that the German vocational training system provides employees with high and firm-specific skills (see e.g. Hall and Soskice 2001a: 25-26; Soskice 1999: 108). This suggests that low skills should be understood as primary education only. However, as indicated by table 4.2., no significant correlation can be seen between employees with primary education and the pursuit of an LCP strategy. In other words, Low Cost Producers do not use significantly more employees with primary education than Diversified Quality Producers or Radical Product Innovators ($R_{Pearson} = .061$; $R^2 = .004$; $p > 0.10$ (2-tailed test)). Interestingly, though, a correlation analysis between employees with primary *or* secondary education and the pursuit of an LCP strategy provides significant results. So, if we use the broader definition of low skill levels, LCPs are found to employ more low skilled labour than Non-LCPs ($R_{Pearson} = .329$; $R^2 = .108$; $p < 0.01$ (2-tailed test)).

Does this mean that the VoC hypothesis on skill levels holds true if *low skills* are defined in a broader manner? In other words, do Radical Product Innovators and Diversified Quality Producers rely on highly skilled employees with tertiary education, whereas Low Cost Producers employ low skilled workers with primary or secondary education? At first sight, this hypothesis seems to be confirmed by an analysis correlating employees with tertiary education and the pursuit of an *RPI strategy* ($R_{Pearson} = .492$; $R^2 = .242$; $p < 0.01$ (2-tailed tests)). However, no positive correlation can be found between employees with tertiary education and the pursuit of a *DQP strategy* ($R_{Pearson} = -.165$; $R^2 = .027$; $p > 0.10$ (2-tailed test)).

How can these results be explained? Let us recall our observation of table 4.2. that firms pursuing an RPI strategy employ notably more people with tertiary education than firms which pursue a DQP or an LCP strategy. Yet Diversified Quality Producers and Low Cost Producers do not only employ a comparatively less skilled workforce, they also employ about the same extent of workers with primary and secondary education. The fact that Diversified Quality Producers and Low Cost Producers pursue similar employment policies seems to be the reason for which the correlation between tertiary education and an RPI strategy leads to a significant positive result, whereas the correlation between tertiary education and a DQP strategy produces a weak negative outcome.

To rule out any further doubt, it is most useful to resort to multi-nominal logistic regression analyses. Overall, I carried out three analyses in order to assess the individual impact of primary, secondary, and respectively tertiary education on competitive strategy. To provide a complete picture, I used each competitive strategy as a reference category in a separate model, meaning that each regression analysis contains three models. Table 4.3. summarises the results. In so doing, table 4.3. does not only report the individual impact of each education level on competitive strategy; it also allows us to deduce the impact of the education levels on the strategy in question. For example, the first regression analysis does not only teach us that Radical Product Innovators rely significantly more on employees with tertiary education than Diversified Quality Producers on the one hand (Exp (B) = $+1.048$; $p < 0.01$), and Low Cost Producers on the other (Exp (B) = $+1.073$; $p < 0.01$). These results also allow us to deduce that Radical Product Innovators employ less low-skilled workers with primary *or* secondary education than Diversified Quality Producers (deduced Exp (B) = -1.048; $p < 0.01$) and, respectively, Low Cost Producers (deduced Exp (B) = -1.073; $p < 0.01$).

Table 4.3.: Impact of 1ary, 2ary and 3ary Education on Competitive Strategy
Results of Multi-Nominal Logistic Regression Analyses (Standardised B)

Independent Variable:	Model 1: Dep. Variable: Co.Str. (Reference Category: RPI)		Model 2: Dep. Variable: Co.Str. (Reference Category: DQP)		Model 3: Dep. Variable: Co.Str. (Reference Category: LCP)	
	DQP	LCP	RPI	LCP	RPI	DQP
3ary Education Exp (B)	.954***	.932***	1.048***	.977	1.073***	1.024
$R^2_{Nagelkerke}$	.284		.284		.284	
2ary Education Exp (B)	1.042**	1.061***	.960**	1.018	.943***	.982
$R^2_{Nagelkerke}$	.210		.210		.210	
1ary Education Exp (B)	1.020	1.022	.980	1.001	.979	.999
$R^2_{Nagelkerke}$	.022		.022		.022	

Significance levels: * < 0.10 ** < 0.05 * < 0.01**

In a word, the results reported in table 4.3. confirm the observations of table 4.2.: contrary to the VoC predictions, Diversified Quality Producers and Low Cost Producers pursue highly similar employment policies. They do not only rely less on employees with tertiary university education than Radical Product Innovators, they also employ roughly the same amounts of people with secondary and primary education. Furthermore, the results obtained from the analyses on primary education are particularly interesting to the extent that neither RPIs, nor DQPs, nor LCPs make significant use of this skill category. This, in turn, supports our previous observation that firms avoid the employment of workers with primary education irrespective of their competitive strategy. Overall, these results contradict the VoC hypothesis that Low Cost Producers rely mostly on low skilled employees, whereas both Radical Product Innovators and Diversified Quality Producers employ highly skilled labour (Estevez-Abe et al. 2001: 174-176; Hall and Soskice 2001a: 39-44). Albeit not in line with the VoC hypotheses, our findings also indicate that certain strategies require specific skill types more than others. It will be the aim of the following sections to reveal to what extent and why systematic variations can be observed in the skill levels employed.

4.2.2.2. SKILL LEVELS: NECESSARY INPUT FACTOR, OR CONSEQUENCE OF COMPETITIVE STRATEGY?

Before I set out to interpret the previous findings, it is necessary to test the *relative* importance of skills for competitive strategies. The two previous chapters have shown that specific types of finance and standards do not automatically constitute necessary input factors for the pursuit of a competitive strategy. Let us recall that finance turned out to have a *facilitative impact on* strategy (see chapter 2), whereas standards were found to emerge *as a result of* a firm's strategy (see chapter 3). With regard to labour skills we have, so far, only seen that significant covariation exists between skill levels and competitive strategy. But do skill levels (most notably employees with tertiary education) actually constitute a *necessary input factor for* the pursuit of an (RPI) strategy? Or are employees (with tertiary education) hired *as a result of* a firm's choice to pursue an (RPI) strategy?

While arguments on causal relationships should and will not be based merely on quantitative analyses, we would find empirical support for the idea that skill levels constitute a necessary input factor *if* they have a stronger impact on competitive strategy than any rival explanatory factor. In chapter 2 (section 2.3.2.), we saw that, of all potential rival explanators, a *firm's age* has the strongest facilitative impact on the pursuit of a competitive strategy. Consequently, I re-ran all the multi-nominal regression analyses described in section 4.2.2.1. (see table 4.3.) with *firm-age* as a second independent variable in each analysis so as to test the relative importance of *skill levels* for *competitive strategy*. In order not to annoy the patient reader with repetitive information, suffice it to say here that skill levels qualified unambiguously as more important for the pursuit of a competitive strategy than a company's age[90]. When I used a stepwise method (forward entry) instead of the enter method, results were identical to those presented in table 4.3.[91]. This allows us to conclude that different skill levels in general, and tertiary education in particular, constitute a necessary input factor for the pursuit of a competitive strategy.

Having found skill levels to be of decisive importance *for* competitive strategies, we should also test whether people with a specific educational degree are employed *as a result of* a firm's strategy. Should we find that a firm's strategy is a better exlplanator than the strongest

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[90] It will not come as a surprise that the analyses on primary education constitute an exception to this rule. In line with our finding that firms avoid the employment of people with primary education, irrespective of their competitive strategy, a firm's age qualified as the better strategy-predictor than primary education. Nevertheless, we can conclude that skill levels are *overall* more important for the pursuit of a firm's strategy than its age.

[91] In line with the previous footnote, this statement applies to all analyses on tertiary and secondary education, whereas firm-age qualified as the stronger predictor in the analyses on primary education. Yet, also as mentioned in the previous footnote, this does not change our overall finding that specific skill levels constitute a better explanation for competitive strategy than firm-age.

rival hypothesis on why certain skill levels are employed, we may deduce that skill levels do not only constitute an important input factor, but that a firm's employment policy is also determined by its strategy[92]. So, do skill levels 'only' constitute a necessary input factor, or are they also the result of the competitive strategy pursued? To this end, a rival hypothesis for the employment of skill levels is required. When I tested the explanatory strength of potential rival explanators[93], a firm's *number of employees* emerged as the strongest predictor of skill levels. Accordingly, I formulated the following rival hypothesis for the employment of people with higher education: small firms are more likely to rely on a workforce with tertiary education because employees are confronted with a larger variety of tasks than tends to be the case in big companies. Highly skilled employees seem more prepared to meet this challenge and cope with a variety of responsibilities than employees with primary or secondary education.

To assess whether the employed skill levels are a function of a firm's size rather than of its competitive strategy, I carried out several linear regression analyses[94]. Interestingly, these analyses show that a firm's strategy constitutes a significant explanation for the extent to which a workforce with higher (namely tertiary and, even more importantly, secondary) education is employed. However, the skill profile of employees is even better explained by a company's size. A firm's strategy does not qualify as the stronger explanation for the skill levels employed in any of the analyses. These results indicate that a firm's employment policy is *not* determined by its competitive strategy. Accordingly, we can conclude that certain skill levels in general, and employees with tertiary skills in particular, constitute a necessary input factor for the pursuit of an (RPI) strategy, rather than being the consequence of it.

4.2.2.3. Summarising and Interpreting the Findings on Skill Levels

To conclude our study on skill levels, let me summarise and interpret the previous findings. In so doing, I will combine qualitative insights obtained in the course of my interviews with findings resulting from the previous quantitative analyses. Overall, we found the VoC contributors (Hall and Soskice 2001a: 39-44; Estevez-Abe et al. 2001: 174-176; King and Wood 1999: 376) wrong in suggesting that Radical Product Innovators and Diversified Quality

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[92] Should this turn out to be the case, diachronic analyses would become necessary to assess *over time* whether certain skill levels are employed *for*, or respectively *as a function of* a firm's strategy.

[93] More precisely, I assessed the explanatory strength of a firm's *country*, its *age* and its *number of employees* for the employment of skill levels by correlating each indicator individually with *tertiary education*.

[94] To be precise, I carried out six linear regression analyses, all of which tested the impact of a firm's *number of employees* and its *competitive strategy* on one *skill level* (i.e. firstly on *tertiary*, then on *secondary* and finally on *primary education*). In so doing, I run each of these three analyses initially on the basis of the enter method, and then on the basis of a stepwise (namely the forward entry) method.

Producers require highly skilled employees, whereas Low Cost Producers tend to employ low skilled labour forces. Instead, we have seen that firms pursuing an RPI strategy rely on a highly skilled workforce with tertiary education, whereas firms pursuing a DQP or an LCP strategy resemble each other in that they recruit many employees with secondary education. Low skilled employees with primary education are hardly employed by RPIs, DQPs or LCPs. That said, it should be remembered that country-specific variations could be observed: in the UK, where no national vocational-training system exists, employers find it more difficult to recruit employees with secondary education than in Germany with its well developed vocational training system. Italy, in turn, is situated in between.

What do these findings teach us? It is rather unsurprising that companies specialising in research and development activities require a high number of scientists who, usually, hold university degrees. Hence, it is easily understandable that Radical Product Innovators focusing on early value-chain activities substantially rely on employees with tertiary education. Contrary to Radical Product Innovators, Diversified Quality Producers do not concentrate on research and development activities. They are also active in downstream activities such as production, marketing and sales. Accordingly, it is also understandable that Diversified Quality Producers employ scientists, managers, and department heads with tertiary education, as well as production and sales employees with secondary and, occasionally, primary education.

But why do (most notably German and Italian) Low Cost Producers with a focus on production, marketing and sales activities not employ more 'inexpensive' workers with primary education? Two explanations may help us to understand this seeming paradox: firstly, a regulatory aspect. Since health risks related to the administration of drugs are high, European legislation imposes strict conditions on the purity of pharmaceutical products. More precisely, European legislation requires every pharmaceutical company to respect the EU Guidelines of Good Manufacturing Practice (henceforth GMP). Otherwise, a firm is not granted product approval. With regard to employee skills, the GMP guideline stipulates that '[t]he manufacturer should have an adequate number of personnel with the necessary qualifications and practical experience' (EudraLex 2003: chapter 2). Depending on how this stipulation is implemented in national law, it means that pharmaceutical companies are only allowed to employ people below a certain age limit if the latter have completed at least secondary education. This partly explains why the sales force, and even production workers of Low Cost Producers are rather highly skilled.

Yet, there is a second and, in the eyes of my interviewees, even more important explanation for the high skill levels of pharmaceutical employees: highly skilled employees are

highly productive! If it were true that low labour costs were crucial for successful low-cost production, we would find Low Cost Producers relocating their (production) facilities to low-wage countries. Yet this is not the case. It is well documented that the pharmaceutical industry is particularly dynamic due to its technology intensity. This means that consolidation (most notably mergers and acquisitions) is the order of the day (see Wittner 2005). But such phenomena are common to all countries. And, even more importantly, relocation from high- to low-wage countries cannot be observed. Thus, the consolidation of pharmaceutical firms in general, and of Low Cost Producers in particular, results from the need to achieve economies of scale rather than from reduced competitiveness due to excessively high wages (see Erdmann and Gabriel 2005 in general and p.44 in particular).

This is interesting in that strands of neoclassical trade theory (Heckscher 1919: 57; 55; Ohlin 1933: 7; 50-54) and neoliberal economic theory (Sinn 2005) claim that Low Cost Producers are not competitive in high-wage economies. However, our findings show these claims to be wrong: Low Cost Producers in high-wage countries do not show any sign of being less competitive because they (are forced to) employ 'excessively expensive' labour. Interestingly, the predominant focus of neoclassical and neoliberal arguments on labour costs leads them ignore the importance of labour productivity as related to wages (in particular Sinn 2005: 30-32). From an economic perspective, wages are nothing but the compensation of employees for their productive contribution to a company. Hence, companies – including Low Cost Producers – can very well afford to pay employees high wages if they are highly productive. And employees are highly productive if they are highly skilled.

Indeed, when asking HR managers from German and Italian Low Cost Producers whether a workforce with high education would constitute an undesirable cost burden, their answers pointed in the opposite direction: skilled and 'expensive' employees were perceived as highly beneficial because they are able to work autonomously, thereby being more productive than employees with low skill levels who require constant supervision. Interestingly, this idea was also confirmed by HR managers from British Low Cost Producers. Instead of perceiving a low-skilled workforce as beneficial for the pursuit of an LCP strategy, HR managers repeatedly lamented the general skill shortage in those occupational groups which, in Germany and Italy, typically undergo vocational training. In so doing, British HR managers agreed that they were more than willing to pay higher wages for employees with higher skills since the latter were more productive. It is also interesting to note that these insights confirm our previous observation: firms prefer to avoid employing people with primary education irrespective of the competitive strategy they pursue.

In sum, country-specific variations in the employment of workers with secondary and primary education suggest that a balance exists between the educational level of employees and their productivity on the one hand, and their wage levels on the other. The longer employees are in education, the more they are productive, the higher the wages they can duly claim. This balance seems to be the reason why different skill levels do not have a significant impact on the pursuit of a DQP and an LCP strategy. But, if the balance between skill levels and labour productivity means that levels of education are irrelevant for the pursuit of a DQP and an LCP strategy, then why do Radical Product Innovators rely so much on employees with tertiary education? It is the aim of section 4.2.3. in general, and section 4.2.3.2. in particular, to address this question.

4.2.3. Verifying the VoC Hypotheses on Skill Profiles

4.2.3.1. Testing the VoC Hypotheses on Skill Profiles

Having seen that the VoC hypotheses on skill levels lack empirical support, this section assesses the VoC hypotheses on skill profiles. If the latter hold true, we should find that Diversified Quality Producers rely on a workforce with firm-specific skills, because an in-depth knowledge of their company enables employees to improve and adopt products to the specific needs of customers, and to rectify mistakes autonomously (Hall and Soskice 2001a: 39). Furthermore, we should find that Radical Product Innovators rely on employees with field-specific skills as the latter are more able to adapt to new challenges (see Hall and Soskice 2001a: 40; Estevez-Abe et al. 2001: 174). Although the VoC literature remains silent on the importance of firm- or field-specific skills for an LCP strategy, I include Low Cost Producers in the following analyses because they constitute an important control group.

But how to measure firm- and, respectively, field-specific skills? Let us recall that I defined *firm-specific skills* as those skills that are useful only within the context of one firm because they are based on the knowledge of how a firm operates (see Becker 1975: 26-27). In contrast to this, I defined *field-specific skills* as that type of skills which can be used in all firms requiring a certain business function (see Becker 1975: 19-20). The VoC scholars (Hall and Soskice 2001a: 27; 41; Estevez-Abe et al. 2001: 145; 150-151) repeatedly point to the importance of long *employment tenures* as a means of providing employees with firm-specific skills. Short employment tenures, by contrast, are said to make employees acquire field-specific skills (Hall and Soskice 2001a: 30). *Vocational training* is described as a further possibility of endowing (future) employees with firm-specific skills (Hall and Soskice 2001a: 25). Accordingly, the absence of vocational training is held to make (future) employees invest in field-specific skills

(Hall and Soskice 2001a: 30). Finally, firm- and, respectively, field-specific skills can result from the *on-the-job training* of employees. Depending on the types of courses offered, employees can acquire in-depth insights into how their firm operates; or they can learn more about their business function and, hence, their field of activity.

To measure whether a firm relies on employees with firm- or field-specific skills, I created a *firm-specificness* and a *field-specificness* indicator. These indicators reflect the extent to which skills are firm- (field-) specific due to long (short) *employment tenure*, to (no) *vocational training*, and to the type of *on-the job training* offered to employees. Since the field-specificness indicator takes the reciprocal value of the firm-specificness indicator, suffice it to describe how the firm-specificness indicator is composed. Overall, I assigned up to 5 points to a company according to the following three aspects: I attributed up to 2 points according to the *average job tenure* of employees[95]. Whenever job tenure was lower than 3.9 years, I awarded 0 points, because employees presumably have field- rather than firm-specific skills. 1 point was assigned for job tenure between 4 and 7.9 years, and 2 points were allocated to firms with average job tenure of more than 8 years because in the course of such a long employment period employees are likely to gain an in-depth understanding of how their firm operates[96]. Secondly, I used the extent to which companies *employ former trainees* as a further benchmark for evaluating the firm-specificness of employee skills. In so doing, I allocated no points to firms which did not offer (vocational) training to young people still in education. Similarly, I did not attribute a point where a company offers (vocational) training to people without aiming at employing them at the end of their educational program. The reason for this is that, in the latter case, firms use trainees as a source of inexpensive labour rather than as an opportunity for training future employees in firm-specific skills. Consequently, I attributed 1 point to firms whenever they employed former trainees at the end of their (vocational) education period[97]. Thirdly, I considered the extent to which a company provides *annual on-the-job training courses*. Whenever less than 50% of a firm's employees received on-the-job training, *or* whenever more than 50% participated in on-the-job training courses which provided them mostly with *general* skills, 0 points were assigned. 1 point was given if at least 50% of a firm's employees received on-the-job training for acquiring mostly *industry-specific* skills. Finally, I allocated 2 points to those companies where at least 50%

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[95] For the literal phrasing of the question on average job tenure, consult question 2A)2.1.2. of the questionnaire (see appendix).

[96] The reason for which I chose 4 and 8 years as thresholds is that the first and second promotions usually takes place within these time spans, and an employee's decision to change company is highly influenced by a firm's attitude towards promotion. However, interviews also revealed that the longer employees work for one firm, the less likely they are to change. It is for this reason that I did not introduce any further thresholds (e.g. 12 years).

of the workforce participated in on-the-job training courses providing them with *firm-specific* skills [98].

Table 4.4.: Firm-, and Field-Specificness of Employee Skills on a Scale from 0 to 5, detailed by Country and Competitive Strategy

Group of Firms	No. of Cases	Firm-Specificness (the higher the score, the more firm-specific the skills)	Field-Specificness (the higher the score, the more field-specific the skills)
Average RPIs UK	7	1,4	3,6
Average DQPs UK	8	3,4	1,6
Average LCPs UK	4	2,0	3,0
Overall Average UK (all UK Firms)	19	*2,4*	*2,6*
Average RPIs Germany	7	1,7	3,3
Average DQPs Germany	12	3,7	1,3
Average LCPs Germany	9	3,1	1,9
Overall Average Germany (all German Firms)	28	*3,0*	*2,0*
Average RPIs Italy	7	1,7	3,3
Average DQPs Italy	10	3,7	1,3
Average LCPs Italy	4	2,3	2,7
Overall Average Italy (all Italian Firms)	21	*2,8*	*2,2*
Overall Average RPIs	21	1,6	3,4
Overall Average DQPs	30	3,6	1,4
Overall Average LCPs	17	2,6	2,4
Overall Average (All Firms)	68	*2,7*	*2,3*

Source: Own illustration, evaluating questions 2A)2.1.2, 2A)2.2. and 2A)2.3. (see appendix for questionnaire)

Table 4.4. provides an overview of the extent to which different competitive strategies rely on employees with firm- or, respectively, field-specific skills. Interestingly, and contrary to table 4.2., table 4.4. does not report noteworthy country-specific variations in the extent to which RPIs, DQPs and LCPs rely on employees with different skill profiles. Furthermore, the results reported in table 4.4. are very much in line with the hypotheses proposed by the contributors to the VoC literature (Hall and Soskice 2001a: 39-41; 44; Estevez-Abe et al. 2001: 174). Radical Product Innovators significantly rely on employees with field-specific skills, whereas Diversified

[97] For the literal phrasing of the questions on vocational training, consult question 2A)2.2. of the questionnaire (see appendix).
[98] For the literal phrasing of the questions on vocational training, consult question 2A)2.3. of the questionnaire (see appendix).

Quality Producers employ workforces with firm-specific skills. Interestingly, Low Cost Producers are situated in-between the two, as they recruit employees who have neither pronounced firm- nor field-specific skills. Accordingly, the average scores of Low Cost Producers on the firm- and field-specificness index are very similar to the average national scores.

To assess whether these variations actually result from a systematic correlation between skill profiles and competitive strategies rather than from an unfortunate influence of outlier cases, I ran multi-nominal logistic regression analyses. In accordance with section 4.2.2.1., I carried out two multi-nominal regressions in which I tested the impact of firm- and field-specific skills on competitive strategy. In so doing, I used each competitive strategy as a reference category in a separate model. Hence, each regression analysis is composed of three models. Table 4.5. reports the results of these analyses. Since the firm-specificness indicator takes the reciprocal value of the field-specificness indicator, it will come as no surprise that the results of the two analyses coincide, depending on the competitive strategy used as reference category.

Table 4.5.: Impact of Field- and Firm-Specific Skills on Competitive Strategy Results of Multi-Nominal Logistic Regression Analyses (Standardised B)

Independent Variable:	Model 1: Dep. Variable: Co.Str. (Reference Category: RPI)		Model 2: Dep. Variable: Co.Str. (Reference Category: DQP)		Model 3: Dep. Variable: Co.Str. (Reference Category: LCP)	
	DQP	LCP	RPI	LCP	RPI	DQP
Field-Specific Exp (B)	.093***	.321***	10.696***	3.436***	3.113***	.291***
$R^2_{Nagelkerke}$	.529		.529		.529	
Firm-Specific Exp (B)	10.696***	3.113***	.093***	.291***	.321***	3.436***
$R^2_{Nagelkerke}$	.529		.529		.529	

Significance levels: * < 0.10 ** < 0.05 * < 0.01**

In a word, table 4.5. confirms the results reported in table 4.4.. Most importantly, we find that the three competitive strategies differ significantly from each other in the extent to which they rely on employees with specific skill profiles. As suggested by the VoC scholars (Hall and Soskice 2001a: 39-41; 44; Estevez-Abe et al. 2001: 174), an RPI strategy relies heavily on employees with field-specific skills, whereas a DQP strategy is based on employees with firm-specific skills. Furthermore, it is important to note that Low Cost Producers diverge from both Radical Product Innovators and Diversified Quality Producers in that their employees have

neither firm- nor field-specific skills. While I will discuss the reliability of the *skill-level* and the *skill-profile measure* in section 4.2.3.2., it is important to recall here that Diversified Quality Producers and Low Cost Producers *resembled each other* in the extent to which they employed a workforce with a certain *level* of education (see section 4.2.2.1.). Interestingly, though, they *differ* significantly in the extent to which they rely on employees with specific skill *profiles*.

To complete our analyses, it is necessary to assess the *relative* importance of skill profiles for competitive strategies. Such an assessment is revealing to the extent that skill profiles do not automatically constitute a necessary input factor; they can just as well result from the pursuit of a competitive strategy (see section 4.2.2.2.). So, let us begin by assessing whether skill profiles can be said to constitute a necessary input factor. This would be the case if they were to have a stronger impact on competitive strategy than any rival factor. Drawing on the findings of section 4.2.2.2., we retain a firm's age as the strongest rival explanation for the pursuit of a competitive strategy. Accordingly, I carried out four multi-value logistic regression analyses assessing the relative explanatory power of *skill profiles* and *firm-age* for *competitive strategy*. In parallel with section 4.2.2.2., these analyses first tested the impact of firm-age and field-specific skills, and secondly the impact of firm-age and firm-specific skills on a firm's strategy. In so doing, each analysis initially used the enter method, and then a stepwise (forward) method. Interestingly, skill profiles unambiguously qualified as the better predictor for a firm's strategy than its age[99]. These results can be interpreted to the effect that specific skill profiles actually constitute a necessary input factor.

This idea is confirmed by an assessment of the extent to which specific skill levels are employed *as a result of* the pursued strategy. Remember that the employment of skill profiles would not only constitute a necessary input factor for, but also a result of a firm's strategy, were we to find the latter to be a better predictor of skill levels than the strongest rival determinant. Aiming at identifying the strongest explanation for why specific skill profiles are employed, I carried out three correlation analyses. Correlations between *skill profiles* and a firm's *country*, its *number of employees*, and its *age* revealed the latter to be the best rival predictor. This, in turn, suggests the following hypothesis: the older a firm, the more likely its employees are to have firm-specific skills. The reason for this is presumably that incumbent companies can offer both trainees and employees better opportunities than young firms to acquire firm-specific skills through intra-firm promotion and sophisticated training programs. When testing the relative importance of a firm's *competitive strategy* and its *age* for the workforce's *skill profiles*, I found

both factors to qualify as significant explanators. Nevertheless, a firm's number of employees has a significantly more important impact on skill profiles than the strategy pursued. These findings can be interpreted to the effect that employees with firm- (or field-) specific skills constitute a necessary input factor for the pursuit of a competitive strategy, rather than resulting from the latter.

4.2.3.2. The Relative Importance of Skill Levels and Skill Profiles for Competitive Strategies

Let us recapitulate our findings so far. We have seen that Radical Product Innovators rely on employees with certain *skill levels* (namely tertiary education) and with specific *skill profiles* (namely field-specific skills). Diversified Quality Producers and Low Cost Producers pursue a similar '*skill-level* policy' as they both rely on employees with secondary education. In this, Diversified Quality Producers require a workforce with a distinct *profile* (namely with firm-specific skills), whereas the employees of Low Cost Producers do not need either pronounced firm- or field-specific skills.

Thus far I have treated an employee's *skill level* and his *skill profile* as two independent and additional measures in all analyses. However, the more interviews I carried out, the more I doubted the independence and additionality of the two measures. When I asked HR managers whether some occupational groups leave their company more often than others, it turned out that employees with tertiary education found it easier to change due to the versatility of their qualifications. Employees with secondary (or primary) education, on the other hand, were said to have more difficulties in finding employment elsewhere as their qualifications were particularly adapted to the company. To put it differently, employees with tertiary education find it easier to leave due to the field-specificness of their skills, whereas employees with secondary education have more difficulties in doing so because of their firm-specific skills.

This, in turn, suggests that *education levels* measure two different concepts. On the one hand, *the level of education describes the educational trajectory* of an employee. In section 4.2.2.3., I argued that educational trajectory has an important impact on labour productivity. The longer an employee is in education, the more he is productive. This means that a balance exists between educational trajectories and labour productivity. Yet this balance also means that educational trajectory *per se* is not related to any competitive strategy. I argued this to be the reason for which a significant difference in the employment policies of Diversified Quality

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[99] Indeed, when regressing *firm-age* and *firm-* (or respectively *field-*)*specific skills* on *competitive strategy* using a stepwise (forward entry) method, exactly the same results are obtained as reported in table 4.5. because *firm-age* is excluded as the less significant predictor.

Producers and Low Cost Producers could not be uncovered[100]. In sum, whenever educational levels reflect educational trajectories, no significant correlation can be observed between skill levels and competitive strategies.

On the other hand, *the level of education also seems to measure the skill profile of employees*. Let us recapitulate that tertiary (i.e. university) education teaches rather field-specific skills which can be used in the context of all firms requiring the respective business function. Secondary (i.e. vocational) education, on the other hand, provides more firm-specific skills to trainees, who often undertake an industrial placement in a company as part of their degree. This, in turn, seems to be the reason why a systematic variation between RPIs and non-RPIs was noted in section 4.2.2.1.. Accordingly, this variation does *not* tell us that firms need employees who have completed a *certain educational trajectory*. That is, Radical Product Innovators do *not* require employees with tertiary education. Instead, the variation tells us that firms require employees with specific *skill profiles*. In other words, Radical Product Innovators need employees with field-specific (university) skills, whereas Diversified Quality Producers require a workforce with firm-specific (vocational) training. Yet this finding does not emerge clearly because the inclusion of primary education, which provides neither firm- nor field-specific skills, blurs the picture[101].

Let us use quantitative analyses in order to test whether skill levels and profiles actually measure the same concept, namely skill specificity. To this end, I composed a '2ary-ness' and, respectively, a '3ary-ness' index. These indices exclude the distorting impact of primary education by expressing the extent of employees with secondary (tertiary) education as a share of the overall workforce with secondary *and* tertiary education:

$$\text{2ary-ness} = \frac{\%\text{ of employees with 2ary education}}{\%\text{ of employees with 2ary education} + \%\text{ of employees with 3ary education}}$$

$$\text{3ary-ness} = \frac{\%\text{ of employees with 3ary education}}{\%\text{ of employees with 2ary education} + \%\text{ of employees with 3ary education}}$$

[100] More precisely, I found that HR managers from both DQPs and LCPs have a preference for employing more skilled and more productive workers with secondary education. Yet, whenever the absence of an industry-wide vocational training system led to a scarce availability of employees with secondary education, DQPs and even more so LCPs resorted to employees with primary education as a second-best solution.

[101] Since Low Cost Producers have a distorting impact on the extent to which skill levels describe the skill specificity of employees, I exclude them from all following analyses on the operational independence of the *skill-level* and *skill-profile indicator*. For the same reason, I will also exclude Low Cost Producers from all analyses on the operational independence of the *skill-profile* and *scientific-knowledge indicator* (see section 4.3.2.2.).

This standardisation means that the 2ary-ness index takes the reciprocal value of the 3ary-ness index. If it is true that the skill-level and skill-profile indicators measure the same concept (namely skill specificity), they should be strongly correlated. And, indeed, a correlation analysis provides empirical support for this: $R_{Pearson} = .650$; $R^2 = .423$; $p < 0.01$ (2-tailed test). The idea that the skill-level and skill-profile indices capture the same concept is confirmed by a reliability test between these two measures (standardised Alpha Cronbach = .788) [102].

Apart from correlation analyses and a reliability test, logistic regressions provide further insights. If a competitive strategy requires employees with a certain education level *who also need to have* a specific skill profile, the interaction effect of the two indicators should qualify as a better predictor than any of the two indicators individually. In other words, if it is true that the 2ary-/3ary-ness and the firm-/field-specificness indicators measure the *same* concept, their combined (interaction) effect should *not* explain a competitive strategy better than any single indicator.

To test the combined and individual impacts of skill levels and skill profiles, I ran two logistic regression analyses. In the first analysis, I introduced the 2ary-/3ary-ness index and the firm-/field-specificness indicator in a first model based on the 'enter' method. I then entered their interaction effect in a second model, using the stepwise ('forward: LR') method. Interestingly, the firm-/field-specificness indicator turned out to be such a strong predictor that education level became insignificant in the first model. Results for the second model are not provided, since the interaction effect is too weak as an explanator. Similar findings emerge from the second regression analysis in which I entered all three variables[103] in a single model based on the stepwise (forward: LR) method. Again, the firm-/field-specificness indicator qualified as such a strong predictor that all other independent variables were excluded from the model. This, in turn, suggests that skill levels and skill profiles indeed measure the same concept of skill specificity, because the combination of the two skill types is less important for the pursuit of a competitive strategy than the skill profile alone.

In sum, quantitative analyses support the idea that skill levels and skill profiles measure a single concept. In so doing, the level of education constitutes the less valid measure as it comprises primary education which, in turn, is irrelevant for the provision of firm- and field-specific skills. We can therefore conclude that the only labour-skill factor which companies actually require for the pursuit of different competitive strategies are employees with firm- and, respectively, field-specific skills. While the pursuit of a DQP strategy relies on employees with

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[102] The comparatively low value of the raw Alpha Cronbach (.379) results, firstly, from a nonstandard distribution of cases on the two indices and, secondly, from the different measurement scales on which these indices are based.

firm-specific skills, employees with field-specific skills are necessary for an RPI strategy. The pursuit of an LCP strategy, in turn, requires neither firm- nor field-specific employee qualifications.

4.2.3.3. Summarising and Interpreting the Findings on Skill Profiles

Overall, the assessment of the VoC hypotheses (Estevez-Abe et al. 2001) has provided three noteworthy results. Firstly, education level *per se* is not related to the pursuit of any competitive strategy. The simple reason for this is that a balance exists between the educational level and the resulting productivity of employees. The longer employees are in education, the more they are productive. This finding addresses the concerns of neoclassical (Heckscher 1919: 57; 55; Ohlin 1933: 7; 50-54) and neoliberal proponents (Sinn 2005) that Low Cost Producers are not competitive in high-wage countries. Our findings suggest these concerns to be irrelevant, because highly paid employees are highly productive due to the fact that they have completed higher education. This, in turn, explains not only why firms pursuing an LCP strategy can be found in Germany, Italy, and the UK alike (see chapter 1): it also explains why no noteworthy relocation of Low Cost Producers from high- to low-wage countries can be observed.

Secondly, educational trajectory has a facilitative impact on competitive strategy to the extent that it provides employees with specific skill profiles. While secondary, vocational training teaches firm-specific skills to future employees, tertiary university education provides future employees with field-specific skills. The fact that education level also captures the firm-/field-specificness of employee skills makes it an alternative measure for skill profiles. However, since primary education provides neither firm- nor field-specific skills, the inclusion of this education level distorts the extent to which the education-level indicator reports skill profiles. Therefore, the indicator which evaluates skill profiles on the basis of *job tenure rates*, *vocational training efforts*, and *on-the-job training courses* constitutes a better measure for skill profiles than the educational trajectory of employees.

Finally, and as a corollary of the two previous findings, we have seen that different skill profiles constitute a necessary input factor for the pursuit of different competitive strategies.While Radical Product Innovators require employees with field-specific skills, Diversified Quality Producers need a workforce with firm-specific skills. Low Cost Producers, in turn, differ significantly from both radically and incrementally innovative firms in that they can operate without firm- or field-specific employee skills. Interestingly, the finding that different

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[103] i.e. the 2ary-/3ary-ness index, the firm-/field-specificness index, and their interaction effect.

competitive strategies require different skill profiles raises a new question: given the claim of the VoC scholars (Hall and Soskice 2001a: 24-26; 29-30; Estevez-Abe et al. 2001: 145; 150-155) that national institutions differ notably in the extent to which they provide firm- and field-specific skills, how do Radical Product Innovators and Diversified Quality Producers secure the required skill profiles in different institutional environments? It will be the aim of section 4.2.4. to shed light on this question.

4.2.4. Institutions and Institutional Equivalents providing Specific Skill Profiles

The previous analyses showed that radically innovative firms require employees with field-specific skills, whereas incrementally innovative companies need employees with firm-specific skills. Yet the contributors to the VoC literature (Hall and Soskice 2001a: 24-26; 29-30; Estevez-Abe et al. 2001: 145; 150-155) argue that flexible (and, respectively, rigid) labour markets notably limit the extent to which employers and employees are willing to invest in firm-(field-) specific skills. Hence, the question arises of how the required skill profiles are provided in different institutional environments. That is, how can Radical Product Innovators in rigid labour-market economies secure employees with field-specific skills? And how do Diversified Quality Producers in flexible labour-markets economies acquire employees with firm-specific skills?

Let us start by addressing the first question by analysing how field-specific skills are provided to firms in Germany and Italy, both of which constitute ideal-typical examples of rigid labour-market economies. It should be remembered that the labour-market institutions which are said to further the provision of firm-specific skills and, consequently, to militate against the provision of field-specific skills are the four following ones: a *centralised wage-bargaining system* which leads to equal wage levels for equal qualifications. This, in turn, may make it difficult to incite and reward employees with outstanding qualifications through extraordinary salaries. Furthermore, *works councils with strong authority over layoffs* complicate dismissal, as do *long notice periods*, and the *pronounced use of competition clauses*. Since these labour-market institutions tie employees to one firm, they make frequent job changes difficult with the result that employees acquire firm- rather than field-specific skills (Hall and Soskice 2001a: 24-26; see also Estevez-Abe et al. 2001: 150-155).

But do these labour market institutions actually constitute obstacles to the provision of field-specific skills? When asking HR managers from German and Italian RPIs whether a *centralised wage-bargaining system* was important to their wage-setting policy, they usually denied this to be the case. In Germany, the broad majority of RPIs (namely 86% of all RPIs interviewed) are not *tarifgebunden*. Instead of paying their workforce according to salary levels

determined in industry-wide collective agreements, German RPIs set wages on an individual basis with employees. In Italy, by contrast, all firms in an industry *must* pay their employees at least the salary determined in the *Contratto Collettivo Nazionale di Lavoro* (henceforth CCNL). However, the CCNL only determines the *minimum* remuneration that has to be disbursed. Employers can, and do, pay wages above the CCNL wage floor. Accordingly, the majority of Italian RPIs (namely 57% of all interviewed RPIs) also negotiate wages on an individual basis with their employees instead of paying company-wide wage top-ups. It is interesting to note that, in order to determine adequate salary levels, both German and Italian RPIs draw substantially on the insights of industry-wide salary surveys – as do RPIs in the UK. Overall, these insights suggest that a centralised wage-bargaining system does not hinder employers in rigid labour markets from setting wages according to their company's needs.

In a similar vein, the constraints deriving from labour-market regulation on *works-councils*, *notice periods* and *competition clauses* are also reduced. With regard to the latter, interviews revealed that the use of competition clauses is more widespread in the UK than in Germany and Italy. And, of course, no rule obliges German and Italian RPIs to tie employees to their company by writing competition clauses into employment contracts. Likewise, HR managers in Germany and Italy did not perceive long notice *periods* to be an obstacle when wanting to lay off employees. Instead, the limited number of *reasons* for which employees in Germany and Italy can lawfully be dismissed was sometimes considered a constraint. This is particularly true since German and Italian works councils have an important say in dismissal. Accordingly, they can make sure that these reasons are respected meticulously.

That said, it is important to note that only a limited number of the German Radical Product Innovators interviewed (14%) actually have a works council. In the majority of Italian RPIs, in contrast, a works council is in place (71%), since the latter is said to constitute an important means of communication between employers and employees. Overall we find that communication between managers and subordinates is often so well-developed in smaller RPIs that employees have never asked for a works council to be installed. But even in those cases where larger RPIs have (to have) a works council, and want to dismiss employees for reasons not acknowledged by law[104], works councils are hardly perceived as a constraint. The reason for this is that in such cases it is in the common interests of employers and employees alike to find a compromise, because law suits are costly, tedious, and potentially harmful to both the firm's and the employee's reputation. Depending on the individual relationship between managers and the

[104] i.e. for reasons other than serious economic constraints, or the wilful misconduct of an employee.

works council, the latter is often perceived as a benefit rather than a constraint, because it acts as a mediator.

In sum, interviews with HR managers from German and Italian RPIs suggest that the VoC scholars (Hall and Soskice 2001a: 24-26; see also Estevez-Abe et al. 2001: 150-155) overestimate the stringency of rigid labour-market regulations. A centralised wage-bargaining system, competition clauses, and long notice periods do not force RPI-employers to offer long job tenure. While it is true that limited possibilities for dismissal, in combination with strong works councils, *de jure* militate against short job tenure, they do not *de facto* oblige RPIs to retain an employee against their will.

In addition to this, the interviews also show that the VoC contributors (ibid) underestimate the creativeness with which Radical Product Innovators in rigid labour markets secure employees with field-specific skills. On the one hand, RPIs teach their employees field-specific skills by offering on-the-job training courses, e.g. in regulatory affairs, in specific research areas, or in the field of corporate finance (etc.). On the other hand, given that rigid labour-market regulations complicate the employment of temporary *workers*, both German and Italian RPIs find a variety of ways to secure temporary *collaborators*. Most importantly, German and Italian RPIs cooperate closely with universities and public research institutes: They offer PhD- or post-doc opportunities to young academics, and they also commission research projects from university professors and their assistants. In so doing, Radical Product Innovators gain highly qualified people with field-specific skills to work on their research projects for a limited period of time[105]. In sum, we find that RPIs in rigid labour markets circumvent national institutions through what I will call in the following *improvisation on a contractual basis*: Instead of relying on national institutions, they conclude contracts with the aim of securing project collaborators or providing their employees with field-specific skills.

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[105] It is interesting to note that project collaboration (*collaborazione a progetto*) has even been institutionalised in Italy. Since 1973, the Italian government has launched several initiatives which grant tax relief to firms for employing so-called *collaboratori a progetto* (see DPR 597 1973). These collaborators work on a company's (research) project for a maximum period of three years. Afterwards, firms are expected, but not obliged, to offer open-ended employment to collaborators. But, since recruitment is not compulsory, Italian RPIs often prefer to employ new collaborators instead of retaining the former ones. In other words, Radical Product Innovators (mis)use government subsidies as a means of securing field-specific skills, rather than as an opportunity to endow future employees with firm-specific skills.
These insights suggest that the rigid German and Italian labour market even constitutes an advantage for providing Radical Product Innovators with field-specific skills. In the UK, young academics are more easily absorbed by the labour market because their dismissal is less complicated. Compared to their British counterparts, German and particularly Italian graduates have more difficulties in finding a first job. On the one hand, this makes that the number of young academics willing to gain a first work experience as (management) trainees, *collaboratori*, or assistants to university professors is relatively high. Consequently, German and Italian RPIs can temporarily utilize highly skilled graduates by paying very low remunerations. On the other hand, the large pool of recent graduates looking for a job also stimulates government initiatives which subsidise firms for offering a first job experience.

Overall, these findings suggest that the VoC scholars have an overly deterministic perception of entrepreneurs as mere institution-takers. The variety of ways in which Radical Product Innovators in rigid labour-market economies secure employees with field-specific skills shows that entrepreneurs are less institutionally determined, and more creative than assumed by the VoC literature. This, in turn, indicates that Schumpeter's perception of entrepreneurs as independent innovators is more helpful in understanding how firms gain competitiveness in different institutional environments (see Schumpeter 1934, chapter 4). As Schumpeter points out, entrepreneurs must be highly inventive in order to realise a business idea which entails the competitive advantage of a temporary monopoly in a (new) product market (see Schumpeter 1942: 81-106). This is precisely what we find when studying how entrepreneurs secure required input factors in different institutional environments: They are by no means constrained in that they (have to) pursue the strategy most facilitated by national institutions. Instead, entrepreneurs circumvent those institutions that hinder them in realising their preferred business strategy.

Similar arguments result from the study of how Diversified Quality Producers secure employees with firm-specific skills in flexible labour markets. The VoC contributors point out that a flexible labour market deters both employers and employees from investing in firm-specific training. The reason for this is that *wage-bargaining decentralisation*, *weak works councils*, *short notice periods* and a limited use of *competition clauses* do not assure employers against the risk of poaching, whereas employees are exposed to hire and fire at will (Hall and Soskice 2001a: 29-30; see Estevez-Abe et al. 2001: 150-155). So, how do British DQPs secure employees with firm-specific skills?

When interviewing HR managers from British DQPs, I asked about the importance of the aforementioned labour-market institutions for providing firm-specific skills. Interestingly, it turned out that neither *competition clauses*, nor *notice periods* or *works councils* played a significant role. Even though the use of competition clauses is more common in Britain than in Germany and Italy, they do not *de facto* constitute an important means of tying employees to a firm. The reason for this is that in case of a lawsuit, judges tend to defend the position of the weaker party, i.e. of the employee who wishes to change job. Hence, competition clauses do not assure *employers* of British DQPs against the risk of poaching. Similarly, weak works councils, short notice periods, and a variety of legally admitted causes of dismissal actually expose the *employees* of British DQPs to the risk of layoff.

Nevertheless, Diversified Quality Producers in the UK endow their employees with firm-specific skills in a variety of ways. Firstly, they offer attractive long-term career paths. To give an example, employees are offered the opportunity to participate in on-the-job training courses

which prepare them for intra-firm promotion. Some British DQPs also provide pension schemes which only become attractive in the long run. Secondly, Diversified Quality Producers in the UK invest massively in firm-specific training courses. Finally, they also invest in the education of (future) employees. More precisely, they offer young people the opportunity to do an internship, or to undertake an (industrial) placement as a part of their degree. In so doing, it is the stated aim of Diversified Quality Producers to recruit well performing trainees at the end of their educational program[106]. Furthermore, British DQPs encourage talented employees to enrol in higher education, e.g. to do an MSc in a field which is key to the company's activities. The tuition fees of these programs are usually covered by the company. Obviously, employees are encouraged to obtain such degrees because the firm wishes to retain them upon completion of the program. Before enrolling in higher education, employees of Diversified Quality Producers therefore usually sign a contract with their employer which stipulates that they have to pay back the tuition fees if they change firm upon completion of their degree. In sum, we once again find that firms circumvent national institutions by securing their required skill profiles through *improvisation on a contractual basis*.

These insights again suggest that the VoC contributors (Hall and Soskice 2001a: 29-30; see also Estevez-Abe et al. 2001: 150-155) overestimate the stringency of labour-market regulation. The fact that Diversified Quality Producers in flexible labour markets *can* dismiss employees at short notice does not mean that they *must* do so. Furthermore, the verve with which British DQPs provide employees with firm-specific skills indicates that the VoC contributors also underestimate the creativeness of entrepreneurs.

Considering the efforts of British DQPs to provide employees with firm-specific skills, and the willingness of British employees to acquire such skills, two final questions remain. Firstly, why do DQP *employers* invest in firm-specific training if a flexible labour market entails the risk that skilled employees are poached by competitors? When posing this question to HR managers, they were amazed by my reasoning: why should employees *leave* a firm which actively cares about their education? On the contrary, HR managers pointed out that the more a company invests in skills, the less employees are likely to leave. According to my interviewees, the reason for this is that employees feel their qualifications to be appreciated, which - in turn - raises reasonable hopes that the company will continue to invest in their career. Apart from these

[106] It is interesting to note that the British government is considering institutionalising such training efforts. In 2003, a pilot project was launched which mimics the German vocational training system in that trainees are educated in close collaboration with one company. More precisely, companies offer the opportunity to undertake a one year industrial placement as part of their, overall, three-year training course. While it is still unclear to what extent joint vocational training will be institutionalised, HR managers from British DQPs were very positive about this initiative.

rather practical considerations, another more theoretical reason seems to apply. As pointed out by Becker (Becker 1975: 26-27), firm-specific skills are only useful within the context of one firm. By definition, competitors will not therefore be interested in poaching employees with firm-specific skills because the latter are simply useless to them. Thus, it is rational for Diversified Quality Producers to invest in firm-specific training, irrespective of whether they are based in rigid or in flexible labour market economies.[107]

But why do the *employees* of Diversified Quality Producers in the UK invest in firm-specific skills if they face the constant risk of overnight dismissal? Let us recall that in flexible labour-market economies the cost of further education is entirely passed on to potential employees (see section 4.2.1.). This means that employees who do not want to, or cannot make the investment of enrolling in higher education are left with primary education levels and no specific skill profile. Viewing this situation in the light of the opportunity of receiving firm-specific training, the latter option is definitely more attractive. Even if the employee were to lose their job, they would presumably be better off if they had received (firm-specific) training than if they remained without. Furthermore, the risk of dismissal seems to be less acute for DQP employees than for those of RPIs because the pursuit of a DQP strategy is comparatively less risky. The risk of total failure is reduced. And considering that Diversified Quality Producers rely heavily on and invest in the skills of their workforce, the latter is unlikely to be dismissed overnight. It is therefore rational for employees to invest in firm-specific skills – even if the company which provides such skills is based in a flexible labour-market economy. In sum, apart from its overly deterministic understanding of entrepreneurs and its excessively constraining view of institutions, the VoC literature can be criticised for overestimating the risk of overnight dismissal related to the pursuit of a DQP strategy, and the opportunities related to teaching and acquiring firm-specific skills in flexible labour-market economies.

[107] In line with this reasoning, it is interesting to note that companies actually seek to retain their employees whenever the latter acquire firm-, *and/or* field-specific skills *due to firm-sponsored training*. This is particularly true for employees who are encouraged to do a degree in higher education which is paid by the company. In these cases, employees usually have to pay (a part of) their tuition fees back if they wish to leave the firm upon completion of their degree.

4.3. The Hypotheses of the Innovation Literature on Scientific Knowledge Diversity

As already mentioned in the introduction to section 4.2., different strands of the competitiveness literature propose different hypotheses on the link between institutions, labour qualifications, and their importance for competitive strategies. In section 4.2., I tested the hypotheses proposed by the VoC literature (Estevez-Abe et al. 2001; Hall and Soskice 2001a: 24-27; 29-30; 39-44). The findings resulting from these analyses also called the arguments of neoclassical (Heckscher 1919: 57; 55; Ohlin 1933: 7; 50-54) and neoliberal proponents (Sinn 2005) into question, in that these scholars assert that low *labour costs* are decisive for a firm's competitiveness in general, and for its choice of competitive strategy in particular.

In addition to the VoC literature, the innovation literature proposes another set of hypotheses about how national institutions facilitate the provision of labour qualifications required for different competitive strategies (Hollingsworth 2000: 627-629; Hollingsworth and Hollingsworth 2000: 223-224; Freeman 1992: 170-171; 182; Dalum et al. 1992: 303; Nelson 1993: 511; Patel and Pavitt 1994: 90-92). Yet the innovation literature focuses on the knowledge base of a firm's *scientists* rather than on the skill types of its *entire workforce*. It will be the aim of section 4.3. to present and test these hypotheses. In that, I focus on the arguments of Hollingsworth (2000), as he proposes the most developed hypotheses within the innovation literature. So, let us turn to assess whether institutions provide scientists with diverse knowledge which, in turn, is required for the pursuit of specific competitive strategies.

4.3.1. The Innovation Literature's Hypotheses: How Different Research Systems provide Scientific Knowledge for Different Competitive Strategies

Similar to the provision of adequate labour skills, a coordination problem arises whenever a firm seeks to secure scientists with an adequate knowledge base. More precisely, firms are vulnerable to the 'hold up' problem (see Hall and Soskice 2001a: 24). While this problem potentially applies to a firm's entire workforce, it is particularly acute with regard to scientists, as the latter are key to the innovation potential of a company. Since the concept of hold-up has already been discussed in chapter 3 (see section 3.2.), suffice it to say here that a research project on which several scientists collaborate risks being held up if the latter do not agree on how to proceed. Given the high chance element inherent in R&D activities, scientists may find it difficult to come to an agreement about how to arrive at discoveries, and how to develop them into marketable products.

Given the risk of hold-up related to R&D activities, companies have two possibilities: They can, simply, decide not to employ scientists and ***not to engage in research and development*** which, in turn, eliminates the hold-up problem. However, if companies decide ***to engage in research and development***, the innovation literature suggests that two institutional solutions to this problem exist, which depend on how national research systems are organised. In – what I call in line with previous terminology – ***rigid research systems***, scientists tend to follow a career in close collaboration with one university or research institute. While opportunities are limited and it takes a long time for scientists to obtain tenure, those scientists who secure tenure positions become civil servants and enjoy noteworthy autonomy regarding the research they wish to pursue. In that, senior scientists not only design their own research projects, they also choose their collaborators. Since the careers of junior scientists depend on the support of their *Doktorvater*, the former entertain long-lasting employment relationships with their supervisor (see Hollingsworth 2000: 629). Overall, this means that the ***knowledge of scientists*** working in one area of research is fairly ***homogenous*** because senior scientists rarely change their research focus, while junior scientists collaborate closely and for a long-time with them. Homogeneous scientific knowledge, in turn, leads to hold-up problems being solved in a cooperative way. Hold-up is already less likely to occur because scientists have a very similar perception of how to do research. Furthermore, scientists are used and willing to compromise because rigid research systems make it disadvantageous to leave the team in the case of a disagreement. In sum, scientists employed by companies in rigid research systems have rather homogeneous knowledge which, in turn, means that a hold-up problem – if it occurs – is solved in a cooperative way.

The opposite holds true for – what I call – ***flexile research systems***. In such systems, senior scientists are not civil servants, nor do they enjoy unilateral decision-making power regarding the projects they wish to pursue and the collaborators they want to employ. Instead, only the most promising and rewarding research projects are funded, and the best performing scientists recruited. Since these scientists often come from different universities, countries, and disciplines, research teams are often made up of scientists with very ***heterogeneous knowledge*** (see Hollingsworth and Hollingsworth 2000: 223-224). This, in turn, means that hold-up problems are resolved in a competitive way. In flexible research systems, disagreement and – hence – hold-up problems are more likely to occur due to the diversity of ways in which scientists are used to think about solutions to problems. However, in flexible research systems, scientists who disagree can move on to another university without harming their career. Thus, hold-up problems are solved in a competitive way as the necessity to compromise is reduced so that the most convincing researchers push their ideas through. In sum, scientists employed by companies

in flexible research systems have rather heterogeneous knowledge which implies that hold-up problems are solved in a competitive way.

But how are differences in the knowledge base of a firm's scientists linked to the pursuit of different competitive strategies? Deductive reasoning suggests that the decision to prevent a hold-up problem by not engaging in R&D activities furthers the pursuit of an LCP strategy. Since Low Cost Producers imitate the inventions of others, they simply do not require scientists who search for innovations. This is different for both Radical Product Innovators and Diversified Quality Producers whose competitive success depends on radical and, respectively, on incremental innovation. Accordingly, both RPIs and DQPs need to employ scientists. In so doing, the employment of *heterogeneous scientific knowledge* seems to facilitate the pursuit of an RPI strategy. As contributors to the innovation literature point out, 'it might take an enormous intellectual effort or an extremely creative mind, to identify a potential new combination.' (Lundvall 1992a: 8; see also Johnson 1992: 29). In addition, scientists who have worked in diverse environments collaborating with researchers from different universities, countries and disciplines are more likely to have the necessary innovative potential. That is, scientists with heterogeneous knowledge are more likely to be radically innovative because of their high imaginative capacities. Therefore, heterogeneous scientific knowledge arguably facilitates the pursuit of an RPI strategy (see Hollingsworth 2000: 628; Hollingsworth and Hollingsworth 2000: 223-224).

In accordance with this line of argument, homogeneous scientific knowledge seems to promote the pursuit of a DQP strategy. On the one hand, scientists with homogeneous knowledge have worked within the same field of research and the same team for a long time. Accordingly, they not only have an in-depth understanding of the technological opportunities in this area, they are also *so* used to *one* environment that they presumably have difficulty imagining an entirely new reality. Scientists with homogeneous knowledge therefore seem to lack the creative capacity to come up with radically new ideas. On the other hand, these scientists are also used to cooperating, and to combining their insights in order to develop discovered technologies into incremental innovations. Overall, this means that homogenous scientific knowledge facilitates DQP (see Hollingsworth 2000: 627; 628-629).

In sum, the innovation literature suggests that *no scientific knowledge* promotes the pursuit of an *LCP strategy*, whereas *homogeneous scientific knowledge* is behind a *DQP strategy*. An *RPI strategy*, in turn, seems to be facilitated by *heterogeneous scientific skills*. Table 4.6. provides an overview of these hypotheses.

Table 4.6: Hypothetical Relationships between Scientific Knowledge and Competitive Strategies

Input Factor / Production Strategy	Knowledge of Scientists		
	No Employment of Scientists	Employment of Scientists	
		Homogeneous Scientific Knowledge	Heterogeneous Scientific Knowledge
1. Radical Product Innovation			X
2. Diversified Quality Production		X	
3. Low Cost Production	X		

Source: Own Illustration

4.3.2. Verifying the Innovation Literature's Hypotheses on the Diversity of Scientific Knowledge

Before testing the aforementioned hypotheses, I want to repeat the two methodological remarks made in the introduction to section 4.2.2.. Firstly, it is important to note that the following analyses are grounded on a combination of qualitative insights and quantitative analyses. As mentioned previously, I obtained the data on which the subsequent quantitative analyses are based from carrying out in-depth interviews with Human Resources managers from 69 pharmaceutical companies. These interviews not only allowed me to accumulate quantitative data, they also provided precious insights into the importance of diverse labour qualifications for competitive strategies. These qualitative insights were crucial for structuring and interpreting the following quantitative analyses. Secondly, the quantitative results reported in section 4.3.2. are derived from the overall dataset. It should however be noted that I cross-checked these results by rerunning all analyses for each country separately. Importantly, these country-specific results did not reveal any significant deviations from the overall outcome. That said, let us turn to test the hypotheses of the innovation literature on the importance of scientific knowledge for different competitive strategies.

4.3.2.1. Testing the Innovation Literature's Hypotheses on Scientific Knowledge

To being with, the hypothesis on the pursuit of an LCP strategy is verified without further ado. None of the Low Cost Producers whose representatives I interviewed employed scientists with the aim of discovering and developing radical or incremental innovations. Instead, scientists focus on imitating the inventions of others. Hence, they have clear instructions regarding the purpose of their work, and the means and methods to be employed. This means that the risk of hold-up is eliminated because the outcome of each scientific collaboration is defined from the outset.

This is different for Radical Product Innovators and Diversified Quality Producers alike, both of which employ scientists with the aim of discovering and developing incrementally or radically new technologies. Since the outcomes of such scientific efforts cannot be specified from the beginning, the hold-up problem is acute. But, is it true that Diversified Quality Producers prevent this problem through scientific knowledge *homogeneity*, whereas Radical Product Innovators solve it through scientific knowledge *heterogeneity*? To test this hypothesis, I created a 'knowledge-diversity index'. While the measurement of knowledge diversity is not without its problems[108], the index describes how often the scientists employed by one firm come from a different background. To determine this knowledge diversity, I asked HR managers to indicate from how many different disciplines, countries and universities their researchers originated[109]. I took the average of these three figures as an indicator for the frequency with which scientists have a dissimilar background.[110]

Table 4.7. provides an overview of the results obtained. The figures should be read as follows: on average, every n^{th} researcher has a dissimilar background in that s/he comes from a different discipline, country or university. Hence, the higher the figure, the more homogeneous the knowledge of scientists. If the hypotheses derived from the innovation literature hold true (see Hollingsworth 2000: 627; 628-629; Hollingsworth and Hollingsworth 2000: 223-224; Lundvall 1992a: 8; Johnson 1992: 29), Diversified Quality Producers should score higher on the knowledge-diversity index than Radical Product Innovators. Table 4.7., indeed, shows that British, German, and Italian *RPIs* always achieve scores *below* the national average, whereas British, German and Italian *DQPs* score *above* average. It is furthermore interesting to note that

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[108] The reasons for which the elaboration of a knowledge-diversity index is difficult are manifold. Yet, two questions are of particular prominence. Firstly, firms often work on radical or incremental innovations in collaboration with other companies or research institutes. Hence, the question arises of whether the knowledge diversity of external researchers, being employed by others but working on the research projects of the interviewed company, should also be taken into account. In perceiving collaborations with others as a functional equivalent that allows to make up for missing scientific competences inside the own firm (see section 4.3.3.), I decided to consider only the knowledge diversity of those scientists who are actually employed by the company interviewed.
Secondly, it is difficult to judge the relative importance of diverse knowledge. Does knowledge diversity already increase if only *one* researcher comes from a different background (country, discipline, university), or is a *minimum number* of researchers required? While I retained the first approach for SMEs, I took the second approach in the case of large companies with more than 500 employees. Similarly, the question arises whether the knowledge background of superiors (i.e. senior scientists) leads to stronger knowledge diversity than the knowledge background of subordinates (i.e. junior scientists)? Since the answer most probably varies from one company to the other, I assumed that the background of scientists has the same impact on knowledge diversity irrespective of the position a scientist holds.

[109] For the literal phrasing of these questions, see questions 2B)2., 2B)3. and 2B)4. of the questionnaire reproduced in the appendix.

[110] For more clarity, consider the following example: a company employs 60 researchers who come from 15 different universities, 6 different countries and 3 different disciplines. This means that every 4^{th} (= 60/15) scientist comes from a different university, every 10^{th} (= 60/6) scientist comes from a different country, and every 20^{th} (= 60/3) scientist comes from a different discipline. Thus, on average, every 11^{th} (= (4+10+20) / 3) researcher has a dissimilar background.

the absolute scores of Radical Product Innovators on the one hand, and Diversified Quality Producers on the other, do not indicate any noteworthy country-specific variations.

Table 4.7: Diversity of Scientific Knowledge by Country and Competitive Strategy
(Frequency with which scientists come from different backgrounds)

Group of Firms	No. of Cases	Diversity of Scientific Knowledge	
		Absolute Figures (Every n-th scientist comes from a different background)	% of National Average
Average RPIs UK	5	3rd	18%
Average DQPs UK	8	25th	147%
Overall Average UK (all UK Firms)	13	17th	100%
Average RPIs Germany	6	6th	17%
Average DQPs Germany	10	53rd	147%
Overall Average Germany (all German Firms)	16	36th	100%
Average RPIs Italy	7	10th	38%
Average DQPs Italy	10	37th	142%
Overall Average Italy (all Italian Firms)	17	26th	100%
Overall Average RPIs	18	7th	26%
Overall Average DQPs	28	39th	144%
Overall Average (All Firms)	46	27th	100%

Source: Own illustration, evaluating questions 2B)2., 2B)3. and 2B)4. (see appendix for questionnaire)

While table 4.7. suggests that Diversified Quality Producers need homogeneous scientific knowledge whereas Radical Product Innovators require scientists with heterogeneous knowledge, it is necessary to test the robustness of these findings with the aid of quantitative analyses. A correlation analysis shows that the *knowledge diversity* of a company's scientists strongly correlates with the firm's *competitive strategy* ($R_{Pearson} = .555$; $R^2 = .308$; $p < 0.01$ (2-tailed test)). Needless to say, a logistic regression analysis testing the impact of *knowledge diversity* on the pursuit of *competitive strategy* confirms this result because Low Cost Producers cannot be used as a control category[111].

It is therefore opportune to assess the *relative* importance of knowledge diversity by including a rival explanator for a firm's strategy into the regression analyses. This will also provide insights into the extent to which diverse scientific knowledge constitutes a necessary

input factor. Previous analyses revealed a firm's age to be the strongest alternative explanation for which a firm pursues a certain strategy (see sections 2.3.2.). Consequently, I carried out two logistic regressions in which I tested the joint impact of a firm's *age* and the *knowledge heterogeneity* of its scientists on an *RPI strategy*. In so doing, I used the enter method in the first analysis, and a stepwise (forward: LR) method in the second. As mentioned previously, Low Cost Producers were excluded from these analyses, as they do not employ scientists for R&D activities. The results obtained are summarised in table 4.8.. Interestingly, they indicate that the knowledge diversity of a firm's scientists actually constitutes a necessary input factor for the pursuit of a competitive strategy: the heterogeneity index qualifies as the only significant, as well as much stronger predictor of an RPI strategy in the first analysis. Given the weak explanatory power of firm-age compared to scientific knowledge heterogeneity, the latter is retained as the only significant explanator of a firm's strategy in analysis 2[112]. These results confirm the hypothesis that homogeneous scientific knowledge is required for the pursuit of a DQP strategy, whereas heterogeneous scientific knowledge is necessary for an RPI strategy.

Table 4.8.: Impact of Scientific Knowledge Diversity and Firm-Age on Comp. Strategy Results of Nominal Logistic Regression Analysis (Standardised B)

Independent Variables	**Dependent Variable:** Radical Product Innovation	
	1. Regression Method: Enter	2. Regression Method: Stepwise (Forward LR)
Knowledge Heterogeneity of Scientists	1.378**	1.360***
Firm-Age	1.007	excluded
N	46	46
$R^2_{Nagelkerke}$	.725	.722

Significance levels: * < 0.10 ** < 0.05 * < 0.01**

But does scientific knowledge diversity 'only' constitute a *necessary input factor for* a given strategy, or does the employment of scientists with diverse knowledge also *result from* the strategy pursued? To shed light on this question, a rival explanation for the employment of

[111] The reason for this is that Low Cost Producers do not employ scientists for R&D activities. This absence of scientific knowledge leads to a perfect split between LCPs and non-LCPs which, in turn, does not produce instructive quantitative results.

[112] Since the scientific-heterogeneity index constitutes the reciprocal value of the *scientific-homogeneity index*, identical results are obtained from regressing the latter together with *firm-age* on the pursuit of a *DQP strategy*.

scientific knowledge is required. Various correlation analyses[113] reveal that a firm's age provides the best rival hypothesis: the younger a company, the more heterogeneous scientific knowledge is required. The reason for this is, presumably, that the variety of tasks to be performed by one person is higher in younger than in incumbent firms, and scientists from different backgrounds are more qualified to meet this challenge. A simple linear regression analysis, testing the relative impact of *firm-age* and *RPI strategy* on the basis of the enter method, shows that both predictors constitute important explanations for the employment of *heterogeneous scientific skills*. However, as soon as a forward stepwise method is used, a firm's age qualifies as the better explanation for the scientific knowledge employed. These findings allow us to conclude that the innovation literature (see Hollingsworth 2000: 627; 628-629; Hollingsworth and Hollingsworth 2000: 223-224; Lundvall 1992a: 8; Johnson 1992: 29) is right in suggesting that diverse scientific knowledge (only) constitutes a necessary input factor: while Diversified Quality Producers need scientists with homogeneous knowledge, Radical Product Innovators require scientists with heterogeneous knowledge.

4.3.2.2. The Relative Importance of Skill Specificity and Scientific Knowledge Diversity for Competitive Strategy

In section 4.2.3.2. we found *skill levels* and *skill profiles* to be two different indicators of the same concept, namely *skill specificity*. This finding raises doubts about whether *specific employee skills* and *scientific knowledge diversity* actually measure two different concepts. The knowledge-diversity indicator could simply be an alternative measure of skill specificity. To be more concrete, the question arises as to whether Diversified Quality Producers actually require employees with firm-specific skills *as well as* scientists with homogeneous knowledge? Or, is it sufficient for a DQP strategy that employees have firm-specific skills, with knowledge homogeneity indicating that scientists are endowed with such skills? It could, for example, be imagined that scientists have acquired firm-specific skills by working for a long time in the same company, where they also obtained homogeneous knowledge. Then, firm-specific skills and homogeneous scientific knowledge would merely constitute different measures of the same concept. Obviously, the opposite line of argument applies to the pursuit of an RPI strategy.

So, let us test whether *skill specificity* and *knowledge diversity* are two indicators of the same concept[114]. At first sight, a correlation analysis suggests this to be the case, as the skill-

[113] More precisely, I carried out 3 correlation analyses between *scientific knowledge diversity* and (1) a firm's *country*, (2) its *number of employees* and (3) its *age*.

[114] In line with section 4.2.3.2., I had to exclude Low Cost Producers from all subsequent analyses. The reason for this is that Low Cost Producers do not employ scientists for R&D activities. The absence of scientific knowledge

profile and knowledge-diversity index co-vary strongly ($R_{Pearson} = .512$; $R^2 = .262$; $p < 0.01$ (2-tailed test)). However, a reliability test casts doubt on this idea: while the standardised Alpha Cronbach (.678) is comparatively high, the raw Alpha Cronbach (.088) is extremely close to 0. Yet, the low score of the raw Alpha Cronbach could still be the result of an abnormal distribution of cases and differences in the measurement scale on which the two indices are composed.

It is therefore opportune to resort to logistic regression analyses in order to test whether skill specificity and knowledge diversity measure the same concept. As in section 4.2.3.2., I carried out two logistic regressions. I ran the first analysis with two models: the first assessed the importance of *firm-/field-specific skills* and *homogeneous/heterogeneous knowledge* for *competitive strategy* on the basis of the enter method. The second model added the interaction effects of these two variables and employed a stepwise (forward: LR) method. Interestingly, the results suggest that skill specificity and knowledge diversity measure two different concepts because – contrary to section 4.2.3.2. – *both variables* are retained as highly significant predictors in the first model ($p_{skill\ specificity} < 0.05$; $p_{knowledge\ diversity} < 0.05$). Results for the second model are not provided. In other words, none of the three variables qualifies as a sufficiently significant predictor for competitive strategy if (only) skill specificity and knowledge diversity are tested as main effects. These results indicate that scientists with diverse knowledge do not merely form a sub-group of employees with specific skill profiles. They are required in addition to the latter.

The second logistic regression analysis confirms these findings: as in section 4.2.3.2., I tested the explanatory power of *specific employee skills*, *diverse scientific knowledge* and the *interaction term* of these two variables in a single model using a stepwise (forward: LR) method. The results obtained are noteworthy in that they contrast with the results of section 4.2.3.2.: neither the skill-profile nor the knowledge-diversity index is retained as the strongest predictor. Instead, the interaction effect – now treated as an additional main effect – qualifies as the strongest predictor of competitive strategy. This suggests that a competitive strategy not only requires employees with specific skills and, if possible, scientists with diverse knowledge. Instead, the strategy in question can *only* be pursued if both of these factors are present. Accordingly, Diversified Quality Producers need firm-specific employee skills in combination with homogeneous scientific knowledge, whereas Radical Product Innovators require field-specific employee skills combined with heterogeneous scientific knowledge. We can therefore

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leads to a perfect split between LCPs and non-LCPs. This, in turn, would have distorted the following analyses on the operational independence of the *skill-profile* and *scientific-knowledge* indicator.

conclude that the skill-profile and knowledge-diversity indicator do *not* constitute two measures for the same concept.[115]

4.3.2.3. Summarising and Interpreting the Findings on Scientific Knowledge

The findings on scientific knowledge diversity are straight-forward. In a word, the hypotheses derived from the innovation literature (see Hollingsworth 2000: 627; 628-629; Hollingsworth and Hollingsworth 2000: 223-224; Lundvall 1992a: 8; Johnson 1992: 29) have proven correct. Since Low Cost Producers imitate the discoveries of others in order to sell at the most competitive prices, they abstain from all R&D activities. Accordingly, they do not need to employ scientists who search for new technologies.

This is different for both Diversified Quality Producers and Radical Product Innovators whose competitive strategies rely on incremental and, respectively, radical innovation. The above analyses have shown that Diversified Quality Producers require scientists with homogenous knowledge. The latter emerges from long-lasting employment relations with scientists from the same or similar disciplines, universities, and countries. The pursuit of an RPI strategy, in contrast, relies on scientists with heterogeneous knowledge which, in turn, materialises due to the diversity of backgrounds from which researchers emanate. What is more, the above analyses have shown that the pursuit of a DQP or RPI strategy not only requires diverse scientific knowledge, but also requires employees with specific skill profiles. Thus, Diversified Quality Producers need scientists with homogeneous knowledge *as well as* employees with firm-specific skills, whereas Radical Product Innovators require scientists with heterogeneous knowledge *in addition to* employees with field-specific skills. Low Cost Producers, in turn, can operate without specific employee skills and without diverse scientific knowledge.

The finding that employee skills and scientific knowledge diversity constitute two independent concepts is noteworthy: it shows that the VoC literature on the one hand (see e.g. Hall and Soskice 2001a; Estevez-Abe et al. 2001), and the innovation literature on the other (see e.g. Hollingsworth 2000),(Hollingsworth and Hollingsworth 2000; Lundvall 1992b) actually propose different arguments. Even though both literatures study the importance of labour

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[115] It should be noted that I cross-checked the results reported in this section according to the following reasoning. If it is true that the *skill-level* and the *skill-profile index* measure the same concept (namely skill specificity), whereas the *skill-profile* and the *knowledge-diversity indicator* measure different concepts, then the *skill-level* and the *knowledge-diversity index* should also measure different concepts. Similarly to the above section and to section 4.2.3.2., I carried out a correlation analysis and a reliability test, as well as two logistic regression analyses. As expected, the respective results confirmed that the skill-level and knowledge-diversity indicator describe two different types of labour qualifications. Thus, they do not constitute proxies for the same concept. I therefore conclude that the pursuit of a competitive strategy requires both employees with specific skills types, as well as scientists with diverse knowledge.

qualifications for competitive strategies, they differ in their research foci. As mentioned previously, the VoC literature considers the firm as a whole and analyses how the qualification levels of the entire workforce impact on the firm's innovative potential. The innovation literature focuses instead on those employees who are key to innovation, namely scientists. In so doing, it studies how scientists are able to come up with radical or incremental inventions. Due to their diverse analytical foci, these two strands of the competitiveness literature do *not* describe the same phenomenon from different research perspectives. Instead, they propose two additional arguments.

4.3.3. Institutions and Institutional Equivalents providing Scientific Knowledge

Like section 4.2., section 4.3. has shown that the pursuit of a DQP and an RPI strategy requires scientists with special qualifications. While Diversified Quality Producers need scientists with homogeneous knowledge, Radical Product Innovators require scientists with heterogeneous knowledge. The pursuit of an LCP strategy instead does not necessitate the employment of scientists because Low Cost Producers do not engage in research and development. Accordingly, firms pursuing an LCP strategy are not affected by institutions regulating national research systems.

This is not the case for Diversified Quality Producers and Radical Product Innovators. In rigid research systems, the concentration of decision-making power in senior scientists means that researchers acquire homogeneous skills. Hence, the pursuit of an RPI strategy seems inherently difficult in such systems. In flexible research systems, in contrast, senior scientists are less autonomous in their decisions, and researchers acquire a more heterogeneous body of knowledge. This, in turn, seems to militate against the pursuit of a DQP strategy.

So, what do RPIs in Germany and Italy do in order to secure scientists with heterogeneous knowledge, given that these two countries constitute ideal-typical examples of rigid research systems? When talking to HR managers from German and Italian RPIs, I discovered that the latter essentially resort to two functional equivalents in rigid research systems. Firstly, they resort to – what I called in chapter 2 (section 2.4.3.) – *importation* in that they hire scientists from abroad. The fact that the German and Italian research systems endow scientists with homogeneous knowledge does not oblige companies to employ them. Instead, it is not uncommon that key positions in German and Italian RPIs are held by foreign scientists. Such importation of scientific knowledge is possible due to open labour markets. Hence, firms avoid

the constraints resulting from national research systems by drawing on international institutions which give them access to input factors provided in other economies.[116]

Secondly, Radical Product Innovators in rigid research systems also circumvent national institutions through what I called in section 4.2.4. *improvisation on a contractual basis*. On the one hand, RPIs increase the knowledge heterogeneity of their scientists by collaborating closely with other (inter)national companies and research institutes. As mentioned in chapter 3 (section 3.3.1.), Radical Product Innovators have a general tendency to carry out research projects in collaboration with others. Interestingly, this tendency is particularly pronounced among Radical Product Innovators in Germany and Italy, which use joint research projects as a means to diversify the knowledge backgrounds of their scientists. On the other hand, German and Italian RPIs expose their scientists to heterogeneous knowledge by encouraging them to publish their research findings, and to present them at (inter)national conferences. Such exposure of ideas to peer review provides scientists with a variety of suggestions on how they could proceed with their work. These examples of entrepreneurial improvisation also illustrate the remarkable inventiveness of German and Italian entrepreneurs when securing scientists with adequate knowledge profiles.

But what about entrepreneurs in flexible research systems? How do British Diversified Quality Producers secure scientists with homogeneous knowledge, considering that the UK constitutes an ideal-typical example of a flexible research system? In a word, my interviews with HR managers from DQPs in the UK confirmed the previous findings: British Diversified Quality Producers circumvent national research systems, most notably by *improvising on a contractual basis*. Importantly, national research-system regulation is by no means constraining to the extent that companies must hire scientists with heterogeneous knowledge. Instead, firms can simply hire scientists who have graduated from the same university, work in the same discipline, and come from the same country. Anecdotal evidence illustrates this point. Until recently, a British biotech firm, which I will call BTF-41 for reasons of confidentiality, pursued an RPI strategy. In so doing, it hired British, Canadian, Polish, Hungarian and Indian scientists who had graduated in 3 different disciplines, namely chemistry, biology and pharmacology. After having discovered a New Chemical Entity, BTF-41 changed its competitive strategy from RPI to DQP in order to

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[116] It is tempting to argue that *circumventing national institutions though importation* is better described as *factor provision through foreign national institutions*, because firms import scientific knowledge provided by the research systems of other economies. Such factor transfer is, however, only possible in open labour markets. Hence, it is *international labour-market regulation* rather than *foreign research systems* which enables companies to secure input factors from abroad. The best example is provided by the European Community where the free circulation of capital, goods, services and people has been guaranteed since the Single European Act of 1986. This makes it easier for Radical Product Innovators to recruit scientists from EU- rather than from non-EU countries.

develop the NCE into several marketable products. Since that time, BTF-41 has only hired *British* scientists who graduated in *chemistry*. This, in turn, demonstrates that national research-system regulation does not constitute a constraint: British companies are free to employ both scientists with heterogeneous, and scientists with homogeneous knowledge.

What is more, entrepreneurs from British DQPs show a noteworthy creativity to sustain, or even to intensify, the knowledge homogeneity of their scientists when *improvising on a contractual basis*. As pointed out above, scientists acquire homogenous knowledge whenever they share the same working environment for an extended period of time. Therefore, the organisation of the national research system plays an important role in endowing scientists with homogeneous knowledge. Yet, once scientists decide to leave academia, the working environment of a company can notably contribute to the cultivation of homogeneous scientific knowledge. That is, the less scientists change company, the more their knowledge homogeneity is fostered. And, as pointed out in section 4.2.4., British DQPs are very inventive in their efforts to tie employees in general, and scientists in particular, to their company. On the one hand, they offer talented employees the opportunity of intra-firm promotion. On the other hand, they also provide attractive pension schemes which, in turn, become financially interesting only if the beneficiary stays with the company for an extended period of time. In sum, British entrepreneurs resemble their German and Italian counterparts in their creativity to secure scientists with the required knowledge profiles.

To conclude, these findings are interesting to the extent that they confirm our previous criticisms of the VoC literature (see section 4.2.4.). While it is true that national research systems provide diverse scientific knowledge, the innovation literature also merits criticism for its overly deterministic perception of institutions (see Hollingsworth 2000: 627-629; see also Lundvall 1992c: 53; Andersen 1992: 75). We have seen that entrepreneurs are by no means obliged to exploit the scientific knowledge which emerges from national research systems. Instead, we have seen that entrepreneurs resort to two functionally equivalent institutions. On the one hand, they circumvent national research systems by drawing on open international labour markets so as to *import* the scientific knowledge they require. On the other hand, entrepreneurs circumvent national institutions by *improvising* and concluding individual contracts with their scientists so as to secure the required knowledge base. Consequently, the innovation literature also needs to be criticised for perceiving firms as mere institution-takers. Contrary to this functionalist view, and in line with Schumpeter (see e.g. Schumpeter 1934, chapter 4; Schumpeter 1942: 81-106), we have seen that entrepreneurs are remarkably independent and creative when acquiring necessary input factors. In sum, institutions are less constraining, and entrepreneurs more inventive, than

portrayed by the innovation literature (see Hollingsworth 2000: 627-629; see also Lundvall 1992c: 53; Andersen 1992: 75).

4.4. Concluding Interpretation

So what have we learned about the link between institutions, labour qualifications and competitive strategies? To begin with, we have seen that different types of qualifications actually constitute necessary input factors. More precisely, the pursuit of an RPI strategy requires employees with field-specific skills and scientists with heterogeneous knowledge. A DQP strategy, in turn, relies on a workforce with firm-specific skills and on scientists with homogeneous knowledge. Low Cost Producers, by contrast, operate without requirements for specific skill profiles or scientific knowledge.

We have also seen that the educational trajectory of employees is *per se* not related to the pursuit of diverse strategies. Instead, a balance seems to exist between the level of education and labour productivity: the longer an employee has been educated, the more he is productive – and, the higher are the wages he can duly claim! This finding is interesting to the extent that strands of neoclassical trade theory (Heckscher 1919: 57; 55; Ohlin 1933: 7; 50-54) and neoliberal economic theory (Sinn 2005) claim that Low Cost Producers are not competitive in high-wage countries. Our analyses have shown this claim to be wrong: since more expensive workers are more productive because they are more educated, companies that wish to pursue an LCP strategy are equally competitive in low- and high-wage countries. This, in turn, sustains the finding of chapter 1 that Low Cost Producers can be found with (almost) the same frequency in high-wage Germany, and in low-wage Italy.

These insights suggest that, of the three competitive strategies, LCP is the least dependent on national regulation. But what about RPI and DQP? Considering that Radical Product Innovators require labour qualifications which are typically provided by flexible labour markets and research systems, how can they compete in Germany and Italy which both constitute ideal-typical examples of labour-market and research-system *rigidity*? And what do Diversified Quality Producers do in the UK, where the provision of the required qualifications seems to be hampered by national labour-market and research-system *flexibility*? Addressing these questions, we firstly found that institutional flexibility (rigidity) must not be confused with institutional functionalism. The fact that national regulation contributes to the provision of *one* type of qualifications does not mean that functionally equivalent institutions cannot provide *different* qualification types within the same economy. Secondly, we have seen that firms are amazingly inventive in using and generating institutional equivalents. More precisely, we found that entrepreneurs resort to two

functional equivalents in order to circumvent national institutions: they *import* heterogeneous scientific knowledge by relying on open international labour markets, and they *improvise on a contractual basis* so as to make sure that their employees in general and their scientists in particular have adequate qualifications.

Accordingly, Radical Product Innovators in Germany and Italy secure their required skill profiles by providing on-the-job training courses which advise employees in field-specific skills. Furthermore, they offer young academics the opportunity to do a PhD or a post-doc in collaboration with their firm, and commission (research) projects from universities. In order to increase the knowledge heterogeneity of their scientists, Radical Product Innovators hire key personnel from abroad. Furthermore, they collaborate intensely with other, often foreign, companies and research institutes. They also encourage scientists to publish their findings in order to present them at (inter)national conferences.

In a similar vein, opposite measures are taken by Diversified Quality Producers in the UK. In order to provide their workforce with the required qualifications, DQPs tie employees in general, and scientists in particular, to their company by offering attractive long-term career opportunities. In so doing, Diversified Quality Producers invest massively in (firm-specific) training, e.g. in courses which prepare participants for intra-firm promotion, and they provide pension schemes which become profit-yielding only in the long run. Finally, they actively participate in the education of young people, e.g. by offering internships or industrial placements in order to retain the best performers upon completion of their degree.

It is interesting to note that the efforts of companies to provide their workforce with required qualifications are sometimes subsidised, or even institutionalised by national governments. Recent initiatives by the Italian and British governments provide telling examples. In 2003, the British government launched a pilot project mimicking the German vocational training system in that firms offered one year of industrial placement to trainees as a part of their overall three-year degree. While it is not yet clear whether this pilot project will translate into the establishment of a national vocational training system, Diversified Quality Producers are very positive about this initiative. In a similar vein, the Italian government has *de facto* institutionalised the efforts of Radical Product Innovators to secure temporary collaborators with field-specific skills. Since 1973, firms have received subsidies for recruiting recent graduates for a maximum period of three years (see DPR 597 1973).

With regard to the initiative of the Italian government, it is furthermore interesting to note that the same institution can be used for different ends. For Italian DQPs, the opportunity to employ subsidised *collaboratori a progetto* provides an important means for training future

employees in firm-specific skills. However, Italian RPIs instead use the government initiative as an opportunity to temporarily recruit employees with field-specific skills. Even though firms are expected to employ the *collaboratori* at the end of the three-year period, recruitment is not compulsory. This means that, at the end of the three years, RPIs tend to employ new collaborators instead of retaining the former ones.

These insights allow us to draw two major conclusions. Firstly, national regulation is *less constraining* than portrayed by various contributors to the competitiveness literature (see in particular Estevez-Abe et al. 2001; Hall and Soskice 2001a: 36-44; Porter 1990: 126-130; Hollingsworth 2000: 627-629; Ohlin 1933: 7; 52-54; Sinn 2005: e.g. 68-69; 75-76; 142-143). Rather than being a constraint, national institutions constitute an opportunity because, if the labour qualifications provided are not required for the pursued competitive strategy, institutional equivalents allow entrepreneurs to make-up for this lack. Secondly, entrepreneurs are decisively *more inventive* than suggested by the competitiveness literature (ibid). Wherever national regulation fails to provide the required labour qualifications, entrepreneurs actively use or develop institutional equivalents. This, in turn, illustrates that entrepreneurs are decisively more than mere institution-takers. Therefore, I consider Schumpeter's perception of entrepreneurs as independent and creative innovators (see e.g. Schumpeter 1934, chapter 4; Schumpeter 1942: 81-106) most instructive for understanding how firms gain international competitiveness by pursuing different strategies in the same institutional environment.

CHAPTER 5: EXCURSUS – CHOICE AND CHANGE OF COMPETITIVE STRATEGY*

5.1. INTRODUCTION

The previous chapters illustrated that the competitiveness literature agrees on one central point: Firms within the same political economy are expected to specialise in the pursuit of same competitive strategy (see Heckscher 1919; Ohlin 1933; Sinn 2005; Porter 1990; Freeman 1992; Lindgaard Christensen 1992; Nelson 1993; Hollingsworth 2000: 626-630; see in particular Hall and Soskice 2001a: 38-44; Estevez-Abe et al. 2001: 174-176; Vitols 2001: 350-360; Tate 2001: 442-455). The reason behind this is that national institutions – most notably financial-, and labour-market regulations – are said to provide input factors which are required for one specific strategy. Seeking to exploit this institutional advantage, firms are expected to pursue this institutionally facilitated strategy. In sum, the competitiveness literature implicitly or explicitly argues that the majority of firms within the same economy (should) *choose* the same competitive strategy (Heckscher 1919; Ohlin 1933: 7; Sinn 2005: e.g. 18-19; Andersen 1992: 68-69; 78; Dalum 1992: 191f.; 199; 203-207; Patel and Pavitt 1994: 82-86; Porter 1990; Hall and Soskice 2001a: 36-44; 56; Estevez-Abe et al. 2001: 146)[117].

The previous chapters have proven this claim to be wrong: most notably, I have shown in the introductory chapter that firms in diverse economies pursue the same variety of competitive strategies. Identifying the crucial input factors and their providing institutions, I furthermore illustrated in chapters 2 to 4 ***how*** firms compete. While these findings imply that a firm's strategy choice cannot be determined by the extent to which national institutions provide specific input factors[118], the question of ***why*** firms choose a certain strategy still remains unexplored. I will seek to answer this question in the present chapter by analysing the causes which make a firm *choose*, and respectively *change* its strategy.[119]

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* I wish to thank Ruth Gbikpi-Nierre, Udo Klomann, Luis Leal, and Michiel Tegelaars for providing me with (information about) the data on which this chapter is based.

[117] This claim is spelled out most directly in the VOC literature. Accordingly, Hall and Soskice write: '[F]irms in [different developed capitalist economies] develop distinctive strategies (...) to capitalize on the institutions available for market or non-market coordination in the economy.' (Hall and Soskice 2001a: 56). Estevez-Abe et al. are even more explicit when laying out the central arguments of their contribution to this literature: 'The upshot of this chapter is that the shape of [national institutions] has bearings on (...) choice of product market strategies'. (Estevez-Abe et al. 2001: 146).

[118] The reason for this is straight-forward: If a firm's strategy choice was determined by the institutionalised provision of input factors, companies in the same economy should specialise in the pursuit of the institutionally favoured strategy – given that each strategy actually relies on specific factors.

[119] It should be noted that from an analytical point of view, strategy *choice* and strategy *change* constitute synonymous events as they are determined by the same cause (see section 5.3.).

It is important to note that these analyses are explorative to the extent that I did not collect data with the explicit aim of addressing the question of strategy choice. Having found that companies in diverse institutional environments pursue the same variety of strategies, it was my major concern to understand *how* firms compete. I therefore focused on the analysis of the *status quo* by collecting synchronic data: I asked interviewees about the input factors their firm required, and about the providing institutions. However, I did not enquire systematically about how these institutions developed, or whether they contributed to the firm's choice of competitive strategy. Such diachronic data is, however, essential for understanding why a firm decides to pursue a specific strategy, because the moment of strategy choice necessarily dates back further than the interview. Nevertheless, the interviews did also provide me with some diachronic data because I asked many open questions about the reasons for which a company relies on specific input factors and institutions. The answers to these questions offered diachronic insights which allow me to address the question of strategy choice.

It will come as no surprise that these insights do not support the argument of the competitiveness literature that firms choose their strategies according to their institutional environment (see Heckscher 1919; Ohlin 1933: 7; Sinn 2005: e.g. 18-19; Andersen 1992: 68-69; 78; Dalum 1992: 191f.; 199; 203-207; Patel and Pavitt 1994: 82-86; Porter 1990; Hall and Soskice 2001a: 36-44; 56; Estevez-Abe et al. 2001: 146). Instead, empirical evidence suggests that firms choose to pursue a strategy as a function of technological opportunities. To give an example, a group of university professors who discovered a new chemical entity which they wish to exploit commercially is more likely to set up a company that pursues an RPI or a DQP strategy than engage in Low Cost Production. Similarly, a galenicist with much experience in the reverse engineering of pharmaceutical products will tend to open his own LCP-firm rather than embark on Radical Product Innovation. I therefore argue that a firm's choice of competitive strategy is not determined by national institutions, but by the extent to which entrepreneurs seize technological opportunities.

To illustrate this argument, the remaining parts of this chapter are organised as follows. Making a final attempt to verify the arguments of the competitiveness literature, I study in section 5.2. whether firms are less capable of surviving if they choose to pursue a competitive strategy which is not supported by national institutions. Since empirical evidence contradicts this idea, I propose an alternative explanation for strategy choice in section 5.3.. Examining three sets of most different firms, I illustrate how they all agree in one central aspect: they all chose, or changed their strategy on the basis of technological opportunities. Section 5.4. concludes with a summary and an interpretation of the various findings.

5.2. The Argument of the Competitiveness Literature: National Institutions as Drivers of Strategy Choice?

Before discussing alternative explanations, it is worthwhile and the aim of this section to explore the arguments of the competitiveness literature in-depth. Let us recapitulate that this literature suggests the institutionalised availability of input factors to be the major determinant of a firm's strategy choice. The reason behind this, again, is that different strategies are said to rely on specific input factors. Since national institutions usually provide just one set of factors, all firms within the same economy are assumed to specialise in the same, institutionally facilitated strategy. Otherwise, firms are internationally less competitive. In a word, the competitiveness literature argues that a firm's choice of competitive strategy is determined by national institutions (see Ohlin 1933: 52-53; Sinn 2005: 56-58; Nelson 1993; Andersen 1992: 68-69; Porter 1990: 67; Hall and Soskice 2001a: 36-44).

In the introductory chapter, I showed this argument wrong by carrying out a synchronic analysis of British, German, and Italian pharmaceutical firms. More precisely, I classified the technology intensity of those research projects which firms had carried out between 1985 and 2004, thereby identifying the underlying competitive strategy. In so doing, my analysis revealed that the technology patterns of research projects are very similar in Germany, Italy and the UK. In other words, pharmaceutical firms were found to pursue the same variety of strategies irrespective of the country in which they were based. This finding contradicts the argument of the competitiveness literature: given that each strategy actually requires specific input factors (see chapters 2 and 4), and given that national institutions provide just one type of factors (ibid), firms obviously do not base their strategy choice on the extent to which national institutions provide required factors (see Heckscher 1919; Ohlin 1933: 7; Sinn 2005: e.g. 18-19; Andersen 1992: 68-69; 78; Dalum 1992: 191f.; 199; 203-207; Patel and Pavitt 1994: 82-86; Porter 1990; Hall and Soskice 2001a: 36-44; 56; Estevez-Abe et al. 2001: 146).

That said, there may be one – and in my view final – possibility for the argument of the competitiveness literature to be proven right. Since the previous analyses are of a synchronic nature, they do not consider whether the pursued strategies are equally stable *over time*. Obviously, most firms do not take national institutions into consideration when choosing their strategy. Yet, it could be possible that firms which choose a non-conformist strategy are punished for their decision by failure in the long run. In other words, whenever a company does not exploit the advantage of pursuing the institutionally facilitated strategy, it is internationally less competitive and sooner or later goes bankrupt, is acquired by, or needs to merge with another

firm. In this case, the competitiveness literature would be right to the extent that firms *are better off* pursuing the same strategy within the same economy.

The reason such cases of failure do not emerge from the introductory analysis is that I evaluated the technology intensity of research projects from a synchronic perspective. As soon as a firm's strategy from the last 20 years had been identified, the firm was included in the sample – irrespective of whether it still exists today. However, the results might look different if the historical development of a company is taken into account. One could imagine that pharmaceutical firms in the UK, Germany, and Italy started to engage in Radical Product Innovation, in Diversified Quality Production, and in Low Cost Production to the same extent between 1985 and 2004. But, at the end of this period, only those firms survived which pursued an RPI strategy in the UK, a DQP strategy in Germany, and an LCP strategy in Italy. All (or at least most) other companies failed because the pursued strategy was not supported by national institutions.

Consequently, the question arises of whether company success is in line with national institutions as predicted by the competitiveness literature (see Heckscher 1919; Ohlin 1933: 7; Sinn 2005: e.g. 18-19; Andersen 1992: 68-69; 78; Dalum 1992: 191f.; 199; 203-207; Patel and Pavitt 1994: 82-86; Porter 1990; Hall and Soskice 2001a: 36-44; 56; Estevez-Abe et al. 2001: 146). To shed light on this question, the two following sections analyse the strategy failures of British, German and Italian pharmaceutical firms. In so doing, section 5.2.1. studies Radical Product Innovators, Diversified Quality Producers and Low Cost Producers together, whereas section 5.2.2. focuses on firms which pursue an RPI strategy.

5.2.1. Strategy Failure in the UK, Germany, and Italy

So let us assess whether the successful pursuit of competitive strategies is dependent on national institutions as predicted by the competitiveness literature (see Ohlin 1933: 52-53; Sinn 2005: 56-58; Nelson 1993; Andersen 1992: 68-69; Porter 1990: 67; Hall and Soskice 2001a: 36-44). When discussing the composition of the final case sample (see chapter 2: introduction to section 2.3.), I pointed out that various firms from the introductory sample (see chapter 1: section 1.3.2.) no longer existed in 2004 in their original legal form. But is it true that company failure is particularly pronounced among DQPs and LCPs in Britain, among RPIs and LCPs in Germany, and among RPIs and DQPs in Italy? To answer this question, table 5.1. summarises how many firms from the overall sample have gone bankrupt, merged, or been acquired since 1985. In so doing, table 5.1. not only considers the 102 cases of the original sample. It also takes into

consideration those 28 companies added to complete the original sample (see chapter 2: section 2.3.)[120].

Table 5.1. distinguishes between those firms that went bankrupt on the one hand, and those that merged or were acquired on the other[121]. The reason for this distinction is that mergers and acquisitions (henceforth M&As) do not necessarily constitute instances of company failure. On the contrary, only (financially) healthy firms become the objects of M&As. This is particularly true in the biotechnology industry where Venture Capitalists perceive the merger or acquisition of 'their' firm as an attractive exit opportunity. Contrary to M&As, bankruptcy incontrovertibly constitutes an instance of company failure. In order to provide an overall idea of strategy stability in the pharmaceutical industry, the last two columns of table 5.1. add up the respective instances of bankruptcy and M&As.

Table 5.1.: Instability of Competitive Strategies in the UK, Germany, and Italy

Country	Strategy	Total	Bank-ruptcies	% of Bank-ruptcies	M&As	% of M&As	Change of Legal Status	% of Change in Leg. Status
UK	RPIs	19	1	5%	6	32%	7	37%
	DQPs	17	1	6%	6	35%	7	41%
	LCPs	10	2	20%	3	30%	5	50%
Germany	RPIs	16	0	0%	2	13%	2	13%
	DQPs	17	1	6%	2	12%	3	18%
	LCPs	12	0	0%	5	42%	5	42%
Italy	RPIs	15	1	7%	2	13%	3	20%
	DQPs	14	1	7%	0	0%	1	7%
	LCPs	10	1	10%	3	30%	4	40%
Overall	RPIs	50	2	4%	10	20%	12	24%
	DQPs	48	3	6%	8	17%	11	23%
	LCPs	32	3	9%	11	34%	14	44%

Source: PHID database as sampled in chapter 1: section 1.3.2.

Irrespective of whether M&As are perceived as instances of firm success or failure, table 5.1. clearly shows that firms go bankrupt, are acquired, or merge irrespective of the competitive strategy they pursue within a given institutional environment. These insights indicate that the competitiveness literature wrongly suggests strategy stability to be in line with national institutions (see Ohlin 1933: 52-53; Sinn 2005: 56-58; Nelson 1993; Andersen 1992: 68-69;

[120] Consequently, 130 companies are considered in table 5.1., namely the 102 original plus 28 added firms.

[121] It should be noted that I classified the few companies, which were included in the original case sample but not identifiable, as bankruptcy cases. The reasoning for this is straight-forward. A massive amount of information is available on the internet regarding mergers and acquisitions of pharmaceutical firms in general, and regarding (the history of) my cases in particular. Thus, whenever I could not identify a firm despite intense internet research, I assumed that the latter went bankrupt some time ago. Otherwise, it would be mentioned in the records of the acquiring company.

Porter 1990: 67; Hall and Soskice 2001a: 36-44). This is particularly obvious for cases of company failure. While bankruptcy is generally rare, the only instance that can be observed in Germany concerns a firm which pursued a DQP strategy. In Italy, bankruptcy is – in relative terms – most widely diffused among Low Cost Producers. Only Radical Product Innovators in the UK show some sign of strategy stability in line with the expectations of the competitiveness literature.

To assess whether differences in the stability of competitive strategies vary significantly between countries, I resorted to cross tabulation tests. Yet the overall number of firms is limited (N = 130). This is particularly true for those firms which went bankrupt, were acquired, or merged in the course of the last 20 years. To restrict the number of cases with an expected count below 5, I distinguished between only 2 instances of 'strategy status', namely between *strategy instability* on the one hand, and *strategy stability* on the other. While I regrouped all firms that went bankrupt, were acquired, or merged into instances of strategy instability, all firms which still exist in their original legal form today were coded as instances of strategy stability. Table 5.2. reports the results of this cross tabs test.

Table 5.2.: Results of Cross Tabs Test (Country x Strategy Stability x Competitive Strategy)

Country				Strategy Instability	Strategy Stability	Total
UK[a]	**Comp. Strategy**	**RPI**	*Count*	*7*	*12*	*19*
			Expected Count	7,8	11,2	19,0
		DQP	*Count*	*7*	*10*	*17*
			Expected Count	7,0	10,0	17,0
		LCP	*Count*	*5*	*5*	*10*
			Expected Count	4,1	5,9	10,0
Germany[b]	**Comp. Strategy**	**RPI**	*Count*	*2*	*14*	*16*
			Expected Count	3,6	12,4	16,0
		DQP	*Count*	*3*	*14*	*17*
			Expected Count	3,8	13,2	17,0
		LCP	*Count*	*5*	*7*	*12*
			Expected Count	2,7	9,3	12,0
Italy[c]	**Comp. Strategy**	**RPI**	*Count*	*3*	*12*	*15*
			Expected Count	3,1	11,9	15,0
		DQP	*Count*	*1*	*13*	*14*
			Expected Count	2,9	11,1	14,0
		LCP	*Count*	*4*	*6*	*10*
			Expected Count	2,1	7,9	10,0

[a] Chi Square = .468 (1 cells = 16.7 % with expected count less than 5); p > .10; Cramer's V = .101; p > .10
[b] Chi Square = 3.706 (3 cells = 50.0 % with expected count less than 5); p > .10; Cramer's V = .287; p > .10
[c] Chi Square = 3.866 (3 cells = 50.0 % with expected count less than 5); p > .10; Cramer's V = .315; p > .10

In a word, table 5.2. confirms the observations made on the basis of table 5.1.: country-specific differences in strategy stability are not statistically significant. Furthermore, Cramer's V indicates that the associational strength between the pursuit of a given strategy, and the probability that it will fail, is weak and statistically insignificant in the UK, Germany and Italy alike. These quantitative results support our previous suspicions about the argument of the competitiveness literature that national institutions determine the success of a firm's competitive strategy (see Ohlin 1933: 52-53; Sinn 2005: 56-58; Nelson 1993; Andersen 1992: 68-69; Porter 1990: 67; Hall and Soskice 2001a: 36-44). It should be noted that I cross-checked these results by carrying out a second cross tabs test in which I distinguished between the 3 instances of strategy status, namely between *bankruptcy*, *M&As*, and *status continuity*. As pointed out previously, the problem with this test is that the number of cases with an expected count below 5 is rather high. Nevertheless, the results are interesting to the extent that they confirm the earlier findings: Chi-square values are statistically insignificant, while values for Cramer's V turn out to be low.[122]

Having found that national institutions do not determine the (in)stability of *specific* competitive strategies, the empirical evidence of table 5.1. points to an alternative explanation for strategy (in)stability. The stability of *any* competitive strategy seems to be influenced by the extent to which national institutions facilitate the provision of seed finance. More precisely, my studies suggest that the more institutions – be they public pension and insurance systems (see chapter 2: section 2.4.3.), or state-sponsored initiatives – further the availability of seed finance, the laxer financiers become when scrutinising a firm's business strategy, and the less stable the financed strategy is in the long run.

Table 5.1. speaks in favour of this hypothesis as it shows British firms to be the most, and Italian firms least susceptible to change, irrespective of the strategy pursued. That is, British firms prove least stable as 41%[123] of all studied companies changed their legal status in the course of the last 20 years. Status-changes in Italy occurred in only 22%[124] of all considered firms. With a

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[122] The previous analyses have shown that no significant differences can be observed concerning the *frequency* with which RPIs, DQPs and LCPs in different economies go bankrupt, merge or are acquired. Importantly, however, these analyses do not say anything about the *pace* with which firms change their legal status. It could still be possible that, in the UK, Diversified Quality Producers and Low Cost Producers (have to) change their status more quickly than Radical Product Innovators. In Germany, by contrast, RPIs and LCPs might be susceptible to change more rapidly than DQPs. Finally, Italian firms pursuing an RPI or a DQP strategy may fail more quickly than their counterparts pursuing an LCP strategy. Such findings would be in line with the competitiveness literature in that national institutions determine the pace of strategy instability. While this could be desirable for firms aiming at rapid M&As or IPOs, it would definitely constitute a disadvantage for all instances of bankruptcy. In order to assess strategy instability over time, probit regression analyses are most instructive. However, the composition of an adequate dataset requires both more information and time than available at the moment. I shall therefore leave these assessments to future research activities.

[123] This figure is derived as follows: (7+7+5) / (19+17+10) = 41%

[124] This figure is derived as follows: (2+3+5) / (16+17+12) = 22%

20%[125] rate of change in legal status, German companies are situated in between. While these figures are approximate due to the relatively limited number of observations, it is interesting that strategy stability is in line with the amount of available starting capital in the respective countries. The relative abundance of seed finance in the UK, which *inter alia* results from private public and insurance systems (see chapter 2: section 2.4.3.), seems to make financiers less severe in their scrutiny before granting start-up capital. The opposite applies to Italy (see also Breschi et al. 2003: 154; Pozzali 2004: 124), while Germany is once again situated in-between. In sum, business ideas presumably have to be particularly promising in countries where seed finance is comparatively scarce which, in turn, means that firms in these countries are also less susceptible to bankruptcy, or M&As – irrespective of the competitive strategy they pursue! While a systematic exploration of my argument would go beyond the scope of this research project, I will provide further empirical support in section 5.2.2..

Another interesting observation can be made on the basis of table 5.1. in that Low Cost Production constitutes the least stable strategy in Germany, Italy and the UK alike. This instability reflects the present trend of global consolidation in the generics industry (see Wittner 2005). Since Low Cost Producers in general and generics producers in particular do not engage in R&D, they are particularly vulnerable to M&As or even bankruptcy, for two reasons. On the one hand, the absence of radical or incremental innovation as a source of value-added means that profit margins are small, while price competition is high. Hence, as soon as Low Cost Producers come under financial pressure, they are particularly susceptible to take-over or bankruptcy because additional expenses cannot be covered by proportionate price increases (see Läsker 2005). On the other hand, take-overs of Low Cost Producers are easier than take-overs of R&D-intense firms because the technological barriers are lower (see Schröder 2004). Thus, in order to achieve the necessary economies of scale, M&As are the order of the day in the generics industry. But, contrary to the expectations of the competitiveness literature, this phenomenon is not country-specific but of a global nature (see Wittner 2005).

In sum, analysing the firm sample on which I ground my research project, I did not find empirical support for the idea that national institutions determine the failure rate of specific competitive strategies (see Ohlin 1933: 52-53; Sinn 2005: 56-58; Nelson 1993; Andersen 1992: 68-69; Porter 1990: 67; Hall and Soskice 2001a: 36-44). That said, it is important to note that the composition and, hence, the analysis of this sample suffers from two flaws. Firstly, the number of cases is comparatively small. Therefore, the figures constitute approximate indicators of general trends rather than confirmed numbers.

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[125] This figure is derived as follows: (3+1+4) / (15+14+10) = 20%

Secondly, the figures on the strategy instability of Diversified Quality Producers and Low Cost Producers are presumably more representative than those derived for Radical Product Innovators. The reason for this is related to age differences between British, German and Italian pharmaceutical companies. Due to the long-standing history of the traditional pharmaceutical industry, the introductory sample contained – for the UK, Germany and Italy alike – roughly the same number of Diversified Quality Producers on the one hand, and of traditional pharmaceutical companies on the other (see chapter 1: section 1.3.2.). Therefore, I had no need to add either Diversified Quality Producers or traditional pharmaceutical firms. This was different for Low Cost Producers because the abstinence of generics companies from R&D entailed that the latter were not included in the original sample (see chapter 2, introduction to section 2.3.). But only a very few genuinely British, German, or Italian generics firms still existed in 2003 (see Wittner 2003: 52-53; 70-73; 133-134). It was therefore possible to incorporate the entire population of truly 'national' generics firms into the final case sample. As a result, the findings on strategy stability are equally representative for DQPs and LCPs in Germany, Italy and the UK alike.

This is different for Radical Product Innovators because of the relative youth of the German, and particularly of the Italian biotech industry, which entailed that few biotech firms were included in the original case sample (see chapter 1: section 1.3.2.). To make up for this, I added 8 Italian and 3 German biotech firms (see chapter 2: introduction to section 2.3.). In so doing, I selected particularly successful firms in order to achieve optimum comparability. Since most of the biotech companies added pursue an RPI strategy, the stability of German and Italian RPIs may be unrepresentatively high. It is therefore opportune to cross-check the previous results on strategy stability for Radical Product Innovators. This shall be the aim of the following section.

5.2.2. Strategy Failure in the British, German, and Italian Biotech Industries

To cross-check the stability of British, German, and Italian RPIs, the 'VentureXpert' database of *Thomson Financial* offers precious insights (see Thomson Financial 2004). In a word, this database provides detailed information about all firms which have received venture capital since the early 1980s (Bernard 2006). As firms can be sorted *inter alia* by industrial activity and country, it is possible to isolate those biotech companies that have obtained venture capital in the UK, Germany and Italy. These companies can be assumed to pursue an RPI strategy for two reasons. On the one hand, chapter 2 (section 2.3.2.1.) demonstrates that a firm's *industry* constitutes an alternative for measuring its competitive strategy. That is, firms which are active in the biotech industry tend to pursue an RPI strategy. On the other hand, chapter 2 (section 2.4.2.)

also shows that *institutional shareholders*, such as venture capitalists, are particularly likely to invest in Radical Product Innovators. Thus, companies which *are active in the biotech industry*, **and** which *have received venture capital* are very likely to pursue an RPI strategy.

While the sample obtained from VentrueXpert is representative for both Germany and the UK, it needs to be completed for the Italian case. Since the Italian biotech industry only started to take off in the early years of the new millennium[126], many firms were not yet included in the VentureXpert database when I sampled the latter in October 2004. To make up for this lack, I consulted the 'Italian Biotech Database' of *Venture Valuation* (see Venture Valuation 2006). This database provides the most complete list of biotech firms which have received, or constitute attractive opportunities for venture investment. Like their British and German counterparts, these companies can be expected to pursue an RPI strategy for two reasons: they are active in the *biotech industry* and constitute (potential) *venture-capital candidates*. Yet, unlike VentureXpert, the Italian Biotech Database does not provide systematic information on bankruptcy, M&As, and firms that have gone public. I therefore consulted experts from the Italian biotech industry (Vingiani 2006), various reports (Chiesa 2004: 14-20; Fornasiero 2004; Muffatto and Giardina 2003: 119) and the companies' web pages in order to identify those firms that had gone bankrupt, or public, that had merged, or been acquired.

Table 5.2. provides an overview of the RPI sample finally obtained, and the extent to which firms have changed their legal status since the mid-1980s. In so doing, the upper part of table 5.2. gives more detailed insights into corporate changes, whereas the lower part regroups the respective events into successful, unsuccessful and ambiguous cases. More precisely, I regrouped all Radical Product Innovators that went public, that are still open for venture investment, or in the phase of registration as instances of strategy success. Furthermore, I categorised bankruptcy as strategy failure, whereas I classified mergers and acquisitions as ambiguous cases. It should be noted that this sample presumably conveys an overly optimistic impression of strategy stability because it only includes those cases that constitute (potential) venture-capital recipients. Having been subject to the scrutiny of venture capitalists, these companies are likely to be engaged in more promising research projects than the average biotech firm in Germany, Italy, or the UK. But, contrary to the sample analysed in table 5.1., this bias towards RPI stability is symmetric. While the extent of actual RPI failure is probably higher than illustrated in table 5.2., this flaw applies to British, German and Italian companies alike.

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[126] The majority of today's most successful biotech firms in Italy were founded between 1999 and 2003 (see Venture Valuation 2006).

Table 5.3.: Instability of Radical Product Innovators in the UK, Germany, and Italy

	UK		Germany		Italy	
In Registration	1	0,8%	0	0,0%	0	0,0%
Active Investment	101	80,2%	140	90,9%	27	79,3%
Went Public	12	9,5%	4	2,6%	4	11,8%
Bankruptcy	1	0,8%	2	1,3%	0	0,0%
Acquisition	8	6,3%	2	1,3%	2	5,9%
Merger	3	2,4%	6	3,9%	1	3,0%
	126	100,0%	154	100,0%	34	100,0%
Successful RPIs: - Active Investment - In Registration - Went Public	114	90,5%	144	93,5%	31	91,2%
Unsuccessful RPIs: Bankruptcy	1	0,8%	2	1,3%	0	0,0%
Ambiguous RPIs: Mergers and Acquisions	11	8,7%	8	5,2%	3	8,8%
	126	100,0%	154	100,0%	34	100,0%

Sources: VentureXpert and Italian Biotech Database as described in the text

The presented figures are telling in many respects. Most importantly, however, they do not provide empirical support for the expectations of the competitiveness literature (see Ohlin 1933: 52-53; Sinn 2005: 56-58; Nelson 1993; Andersen 1992: 68-69; Porter 1990: 67; Hall and Soskice 2001a: 36-44). National institutions do not seem to determine the success of a firm's strategy to the extent that Radical Product Innovators can only thrive in the UK. On the contrary, the aggregate figures on RPI success are strikingly similar for the UK, Germany and Italy alike.

To assess the statistical robustness of this observation, I carried out three correlation analyses. In the first analysis, I correlated a firm's *country* with its *investment status* by assigning an individual score to each of the 6 investment states. The second analysis, in turn, assessed the correlation between the extent to which firms in each *country fail* in the pursuit of a given strategy. In so doing, I distinguished between (0) strategy success (in registration, active investment, went public), (1) neither success nor failure (M&As), and (2) strategy failure (bankruptcy). Finally, I correlated a firm's *country* with *strategy change*, distinguishing between (0) instances of stability (in registration, active investment, went public), and (1) instances of change (M&As, bankruptcy). Interestingly, the results I obtained from these analyses agree in their central finding. They reveal an extremely weak and statistically insignificant relationship between a firm's *country* and 1. its *investment status* ($R = .028$; $p > .10$), 2. the likelihood of

strategy failure (R = -.028; p > .10), and 3. the probability of *strategy change* (R = -.030; p > .10).[127]

Having found the competitiveness literature wrong in assuming that a country's institutions have a significant impact on strategy stability, table 5.2. points to another noteworthy phenomenon. More precisely, it provides empirical support for the aforementioned idea that the *stability of any competitive strategy depends on national institutions to the extent that easy access to seed finance leads to higher strategy instability* (see section 5.2.1.). Interestingly, the VentureXpert database includes more German than British biotech firms, namely 154 against 126. What is more, Radical Product Innovators are least successful in Germany where 1.3% of all companies failed, and are the most successful in Italy where the failure-rate is 0%. While these figures may seem too similar to deserve closer attention, they point to a noteworthy difference in company instability between Germany, Italy and the UK.

To comprehend this difference, and to understand what drives corporate instability, it is necessary to review briefly how the German and the Italian biotech industry emerged. In contrast to Italy, the beginnings of Germany's biotech industry were massively sponsored by the state. Aware that the biotech industry lagged behind other, mostly Anglo-Saxon economies, the German government launched the so-called 'BioRegio' project in 1995/1996, and the 'BioProfile' initiative in 1999. Providing start-up capital and structural support to entrepreneurs, it was the explicit aim of these initiatives to boost the formation of biotech fims. Successful in this intention, a large number of biotech start-ups were founded in Germany in the late 1990s (Ernst&Young 2002: 92-98). This, in turn, explains the comparatively high number of German biotech companies included in the VentureXpert database. Yet public subsidies were only of a temporary nature. Furthermore, many newly established firms were university spin-offs with the result that their founders had little experience in (regulatory) issues concerning clinical development and product commercialisation. These factors constituted major stumbling blocks to the prosperity of Germany's biotech industry because investment in general, and subsidies in particular, declined at the very moment that many start-ups sought to translate their discoveries into marketable products (Magenheim-Hörmann 2005; Hofmann 2004b). As a result, the German biotech industry went through a period of consolidation which was most pronounced between 2003 and 2005. While some companies succeeded in merging or going public, others had to file

[127] It should be noted that I cross-checked the correlation results by running 3 cross tabs tests. In line with the previous correlation analyses, I assessed the associational strength between a firm's *country* and 1. its *investment status*, 2. the likelihood of *strategy failure*, and 3. the probability of *strategy change*. The outcome of these tests agree in that neither Chi Square, nor Cramer's V are statistically significant, whereby Cramer's V also shows very low scores.

for bankruptcy (Hofmann 2005; Hofmann 2004a). Since these developments are very recent, the extent of consolidation was not reflected in the VentureXpert database when I sampled the latter in Oct. 2004.

At first sight, it may be tempting to interpret the German experience in favour of the competitiveness literature: that the pursuit of an RPI strategy is unsustainable in Germany on the long run. However, the development of the Italian biotech industry provides counter evidence which reveals the availability of starting capital to be the actual driver behind corporate instability. Since the Italian government did not provide any substantial (financial) support for the formation of a national biotech industry (Breschi et al. 2003: 145-146), the latter only began to take-off in the early years of the new millennium. At that time, several big pharmaceutical companies decided to close their Italian R&D facilities with the result that the scientists employed there risked losing their jobs. Faced with this situation, several scientists decided to try and set up their own businesses (Pozzali 2004: 122; Chiesa 2004: 9; Breschi et al. 2003: 150). Yet seed finance was difficult to obtain as the Italian government did not provide (major) financial support, while national venture capitalists were virtually absent (see chapter 2: section 2.4.3.). Hence, only those firms with the most promising business ideas succeeded in bearing critical scrutiny on the part of financiers, thereby attracting (share) capital (from abroad) (Breschi et al. 2003: 154; Pozzali 2004: 124). Unlike in Germany, the crystallisation of the Italian biotech industry was therefore characterised by a process of 'Darwinian selection' (Vingiani 2006). On the one hand, this explains why the number of Italian biotech firms is (still) very limited compared to Germany and the UK. On the other hand, this also explains why Italian biotech firms have proven to be particularly stable. Since only the most attractive business ideas obtained start-up capital, few firms have, so far, merged or been acquired, while no instances of bankruptcy are known (Vingiani 2006; Chiesa 2004: 14-20; Muffatto and Giardina 2003: 119; Fornasiero 2004).

In sum, the experiences of the German and Italian biotech industry teaches us that the stability of a *specific* strategy is not determined by the extent to which national institutions provide *specific* (financial) input factors. Instead, the stability of *any* competitive strategy is determined by the extent to which national institutions facilitate the provision of start-up capital. The more seed finance is available, the laxer the scrutiny of financiers, the less stable the financed strategy. But, contrary to the financial input factors analysed in chapter 2, seed finance can take many forms: subsidies, institutional or private share capital, or bank loans. Since this finding applies equally to all three competitive strategies (see section 5.2.1.), a firm's strategy choice is definitely not driven by institutional considerations. But what is it then that makes a

firm choose to pursue one strategy rather than another? It will be the aim of the following section to answer this question.

5.3. TECHNOLOGICAL OPPORTUNITIES AS DRIVERS OF STRATEGY CHOICE

Having seen that a firm's choice of competitive strategy is definitely *not* determined by the extent to which national institutions provide required input factors, I will propose an alternative explanation for strategy choice, and strategy change in this section. It should be noted that *choice* and *change* of competitive strategy are synonymous events from an analytical point of view because they are determined by the same cause. The difference resides in the history of a firm. Whenever a company is set up from scratch, it has to choose the strategy it wishes to pursue. An established firm, by contrast, already pursues a strategy that it may wish to change at a certain point in time. Yet, the reason for which a newly founded firm chooses, and for which an already established company changes its strategy is the same. In the present section, I will discuss instances of strategy choice and change roughly to the same extent.

So what is it that makes a firm choose, or change its competitive strategy? In a word, I argue that strategy choice is determined by technological opportunities. By *technological opportunities* I understand all factors (like corporate facilities, past experience, or professional know-how) which raise expectations for a firm to develop discoveries into incremental or radical innovations, or dash its hopes of being innovative at all. To illustrate this argument, I will discuss several particularly revealing cases[128]. I will present these cases in three groups, whereby each group is composed in such a way as the importance of technological opportunities becomes particularly evident. Accordingly, the first group consists of 3 firms that resemble each other in many respects but three, namely the institutional environment in which they are situated, their technological opportunities, and the pursued strategy. The second group, in contrast, includes 5 firms which constitute prototypical examples of German, and Italian biotech companies. While these two sets of cases differ in a variety of ways, their only common feature consists in the extent to which technological opportunities influenced the firms' strategy choice. Finally, the third group is made up of 3 companies which have changed their strategy at one point in time. While the direction and moment of change, as well as the firms' institutional environment diverge, the determinant of strategy change is always the same: technological opportunities. So, let us examine these three groups of cases one by one.

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[128] While I cannot disclose the names of these companies for reasons of confidentiality, I will prove the correctness of my statements to the scholars evaluating my work.

5.3.1. Similar Firms, Choice of Different Competitive Strategies

One of the most telling examples, also from a methodological point of view, is provided by three biotech firms which are strikingly similar in many respects. Apart from all being active in the biotech industry, they are also active in the same therapeutic area. Albeit independent in their short- and medium-term decisions, all three firms are wholly owned by the same, US company. Furthermore, they are of a similar size as they employ roughly the same number of people. All have a fully integrated value-chain which includes an (R&)D-department, production facilities, marketing and sales structures, as well as administrative support functions. However, the three companies diverge in two crucial aspects: they are situated in three different institutional environments, namely in the UK, in Germany, and in Italy. Furthermore, they also diverge in the competitive strategies they pursue. While the German and British firms are engaged in Diversified Quality Production, the Italian company specialises in Radical Product Innovation.

Since this specialisation runs counter to the expectations of the competitiveness literature, I asked HR managers from each firm about the reasons for their company's strategy choice. Interestingly, the three interviewees agreed in their answer: the choice or change of competitive strategy was motivated by the technological capacities of each firm, and the extent to which these capacities gave rise to hopes for radical or for incremental innovation. When the US holding company bought the Italian affiliate in the early 1990s, the latter had a long-standing history in pharmaceutical research due to its extensive R&D facilities on the one hand, and due its links to internationally renowned research institutes on the other. These technological capacities had not only produced several radical innovations, they also raised hopes for the discovery of further radical inventions. Accordingly, the Italian affiliate continued to pursue a research-focused RPI strategy after its acquisition. This was different for both the German and the British affiliate. When these two firms were bought by the US holding company, their R&D-facilities as well as their academic networks promised incremental rather than radical innovations. Therefore, the German biotech firm continued to pursue a development-focused DQP strategy, whereas its British counterpart changed from a Radical Product Innovator into a Diversified Quality Producer.

5.3.2. Different Firms, Choice of Same Competitive Strategy

Further evidence that firms choose their strategies on the basis of technological opportunities is provided by the emergence of the German, and the Italian biotech industry in general, and by 2 German and 3 Italian biotech firms in particular. As pointed out in section 5.2.2., the German and Italian biotech industry crystallised under very different circumstances.

The firms I cite here as ideal-typical cases are not only examples of Germany's and Italy's most successful biotech firms today, they are also particularly representative examples of their differences.

To begin with, the incentives to set up a biotech firm were diametrically opposed in Germany and Italy. While structural and financial support from the government provided positive incentives for company formation in Germany, the opposite was true for Italy where biotech firms were often founded as a response to downsizing measures by pharmaceutical companies. Furthermore, many German biotech firms were spin-offs from academic institutions, whereas almost all Italian biotech firms spun off from incumbent pharmaceutical companies. Finally, company foundation took place at different points in time. While many German biotech firms were founded in the mid- and late-1990s, most Italian biotech companies were set up at the beginning of the 21st century. Despite these discrepancies, German and Italian biotech firms in general, and the aforementioned examples in particular, agreed in their choice of competitive strategy. Aiming at the commercial development of those radical inventions that were made within the organisation from which the firms in question then spun off all newly founded companies decided to pursue an RPI strategy. This decision was obviously not affected by the extent to which national institutions provided those input factors required for Radical Product Innovation. Instead, the search for all necessary input factors followed the decision to establish an RPI company.

5.3.3. Strategy Change over Time

The previous body of anecdotal evidence will now be completed by three examples of strategy change. A German pharmaceutical firm, which I will name LCP-51 for reasons of confidentiality, constitutes the first example. Until the beginning of the new millennium, LCP-51 was part of a larger pharmaceutical group within which it pursued a DQP strategy. When the increasing need for innovative performance and flexibility led to the splitting of this group, LCP-51 had to reconsider its strategic orientation. Following a prolonged period of reduced R&D efforts, LCP-51's innovation record was bleak. Since its poor innovative performance dashed hopes for early innovation, LCP-51 decided to change its competitive strategy from Diversified Quality Production to Low Cost Production. This decision, in turn, demonstrates how technological opportunities influence strategy change, or better, determine which strategy had best be pursued.

A similar example is provided by an Italian pharmaceutical company which I will call LCP-52 in the following. Until the early 1990s, LCP-52 was a typical marketing specialist in that

it imitated, produced, registered and marketed the products of other pharmaceutical firms. While pursuing these activities, LCP-52 happened to discover a recombinant protein which raised hopes for the development of superior products and, hence, for incremental innovation. In an attempt to exploit this technological opportunity commercially, LCP-52 opened a small research centre and changed from an LCP to a DQP strategy. But, this change in general, and pharmaceutical development in particular were not without problems. While the R&D activities of LCP-52 translated into several patents and international research collaborations, LCP-52 became aware that it lacked both the financial means and the technological expertise to develop its discovery into a marketable product. Consequently, LCP-52 decided to stop its R&D efforts, and closed the research centre in the early 21st century. In other words, LCP-52 changed from the pursuit of a DQP strategy back to the pursuit of an LCP strategy – roughly 10 years after its first strategy change. Akin to the experience of LCP-51, the change (back) from Diversified Quality Production to Low Cost Production was caused by technological opportunities, namely the firm's incapacity to develop a marketable product.

A last case of strategy change is provided by an Italian pharmaceutical firm which shall be named DQP-51 for reasons of confidentiality. Contrary to the two previous cases, DQP-51 changes – and re-changes – its competitive strategy from Diversified Quality Production to *Radical Product Innovation*. To this end, it is important that the firm's innovative activities take place at two levels. Having been among the first Italian firms to open their own R&D laboratories, the national research facilities of DQP-51 constitute the basis for the company's usual activities in incremental product innovation. Furthermore, DQP-51 is a long-standing member of an exclusive, international research network. While this research network was set up to support the firm's DQP activities, it occasionally serves as a platform for the development of radical innovations. That is, even though DQP-51 traditionally aims at incremental product innovation, it occasionally happens to make radical discoveries while pursuing DQP activities. Seizing these technological opportunities, the firm temporarily changes its strategy from Diversified Quality Production to Radical Product Innovation by relying extensively on its international research partners. Once the latter have helped to transform the radical discovery into marketable patents, or even products, DQP-51 changes back to incremental innovation in order to proceed with product improvements.

In sum, what do these diachronic insights teach us? Overall, two noteworthy observations can be made, both of which point in the same direction. Firstly, all the firms studied in section 5.3. are similar in one feature: their choice and, respectively, change of competitive strategy was driven by technological opportunities. Admittedly, this argument is grounded on anecdotal

evidence and, hence, on qualitative rather than quantitative analyses. Therefore, even though the spread of cases seems to be both regular and representative, a quantitative purist might question the extent to which this argument can be generalised.

Yet a second observation, based on all cases of strategy change, underlines the importance of technological opportunities (see section 5.3.3.). Interestingly, all 'strategy changers' chose a new strategy which was technologically close to the former one. That is, firms switched from an LCP to a DQP strategy, and vice-versa. They also changed back and forth from the pursuit of a DQP strategy to the pursuit of an RPI strategy. However, I did not observe a single instance of a firm switching from Radical Product Innovation to Low Cost Production, and vice-versa. The decision to change to a new strategy, (as) close (as possible) to the former technological expertise of the respective firm, underlines how important technological considerations are for strategy decisions. While this observation is explorative to the extent that it is grounded on a rather limited number of cases, it supports the idea that a firm's strategy choice is determined by technological opportunities rather than national institutions.

5.4. CONCLUSION

To complete my analyses of international firm competitiveness, I have attempted in the present chapter to provide a diachronic study of strategy choice. While I analysed in the previous chapters *whether* and *how* firms pursue different strategies in diverse institutional environments, I asked in the present chapter *why* they do so. In other words, I asked why firms choose one competitive strategy rather than another.

To answer this question, I first assessed the argument of the competitiveness literature that firms which pursue a strategy that is not supported by national institutions are comparatively less capable of surviving. The analyses of different data sets led to the same two results. Firstly, companies fail and succeed irrespective of the competitive strategy they pursue within a given institutional environment. Secondly, the only difference in strategy stability seemed to be related to the ease with which entrepreneurs can acquire seed finance. The easier the acquisition of start-up capital, the more likely the firms will change their legal status over time. The reason for this is presumably that firms in favourable seed-finance environments obtain start-up capital even if their business idea is comparatively unpromising.

Having found that the competitiveness literature again overestimates the stringency of national institutions (see Ohlin 1933: 52-53; Sinn 2005: 56-58; Nelson 1993; Andersen 1992: 68-69; Porter 1990: 67; Hall and Soskice 2001a: 36-44), I proposed an alternative explanation for strategy choice. More precisely, I argued that firms choose their competitive strategy on the basis

of technological opportunities. I empirically grounded my argument on studies of various companies which differ in many respects but one: they all chose, or changed, their competitive strategy in line with technological opportunities, namely in line with their expectations of developing discoveries into incremental or radical innovations, or respectively in line with their incapacity to be innovative.

To conclude, it is interesting to note that my findings leave room for speculation about the relationship between institutional constraints or incentives, technological opportunities and strategy choice. Let us recall the findings of chapter 1 (section 1.4.) that pharmaceutical firms in the UK, Germany, and Italy show a slight preference for specific competitive strategies. Compared to the average pharmaceutical company, British firms are 7.0% more likely to pursue an RPI strategy, German companies are 7.5% more disposed to pursue a DQP strategy, and Italian firms are 12.0% more likely to be engaged in an LCP strategy (see table 1.4.). Remember also that these strategy-specialisation patterns turned out to be statistically not significant. To put it in more statistical terms, the cross tabs test of section 1.4. revealed that the probability of observing strategy-specialisation patterns due to a sampling error is more than 10%; 19.9% to be precise. From a statistically conservative point of view, this probability is unacceptably high. We therefore refused the idea that strategy specialisation is of significant importance.

But let us for a moment take a less conservative stance, and accept a 20% significance level. Drawing on the findings of the present chapter, we can then conclude that strategy-specialisation patterns do *not* result from the extent to which national institutions provide input factors (see Heckscher 1919; Ohlin 1933; Sinn 2005; Porter 1990; Freeman 1992; Lindgaard Christensen 1992; Nelson 1993; Hollingsworth 2000: 626-630; see in particular Hall and Soskice 2001a: 38-44; Estevez-Abe et al. 2001: 174-176; Vitols 2001: 350-360; Tate 2001: 442-455). Instead, we can conclude that strategy-specialisation patterns emerge as a result of the extent to which *entrepreneurs seize technological opportunities*. This entails the question of the factors which determine the frequency with which technological opportunities arise, and are seized by entrepreneurs. While a systematic answer to this question would go beyond the scope of my research, I wish to acknowledge that the competitiveness literature might have a point in stressing the importance of institutions – although it misunderstands the underlying causal mechanisms. Apart from a pure historical account, I can imagine two institutional explanations for which entrepreneurs in diverse economies seize technological opportunities with differing frequencies. On the one hand, technological opportunities could to some extent arise as a function of the institutional environment. On the other hand, institutions could 'modulate' an entrepreneur's reaction to technological opportunities. However, it must fall to future research to shed light on

the extent to which technological opportunities are seized as a function of historical developments, or of institutional influences.

6. CONCLUDING INTERPRETATION

It is the aim of my research to understand how firms in different economies achieve international competitiveness. To this end, I have studied the competitive behaviour of more than 140 pharmaceutical firms in the UK, Germany and Italy. I will now summarise and interpret the findings which I obtained from these analyses. In so doing, I proceed in three steps. In section 6.1., I summarise my results and illustrate how they address the central claims of the competitiveness literature. In section 6.2., I focus on the - to date - most developed strand of the competitiveness literature, namely the literature on 'varieties of capitalism' (henceforth VoC). Accordingly, I elaborate on the implications which result from my findings for VoC reasoning. In so doing, I criticise the three central arguments of this literature, finding them to be grounded on a one-sided perception of firms as central determinants of (economic) policy-making. Finally, I illustrate in section 6.3. what implications may be derived for institutional development in general, and for the leverage of national policy makers in designing competitiveness-enhancing institutions in particular.

6.1. VARIETIES WITHIN CAPITALISM: ALTERNATIVE PATHWAYS TO COMPETITIVENESS

So, what do the analyses of the previous chapters teach us about the link between institutions, input factors and competitive strategies? Let us recall that the competitiveness literature agrees in one central point: firms in different economies specialise in the pursuit of different competitive strategies because national institutions provide diverse types of input factors. In other words, specialisation patterns in production and export are explained by the fact that they require specific types of input factors (Heckscher 1919: 56-58; Ohlin 1933: 7; 50-55; Sinn 2005: 18-19; Porter 1990: 67; Hall and Soskice 2001a: 38-41). Since economies differ in the extent to which institutions provide these factors, institutional differences are identified as the main reason for different specialisation patterns (see Ohlin 1933: 52-53; Sinn 2005: 56-58; Nelson 1993; Andersen 1992: 68-69; Porter 1990: 67; Hall and Soskice 2001a: 36-44). This claim is most explicit in the VoC literature. Accordingly, Hall and Soskice write:

> "(...) firms are not essentially similar across nations. On the contrary, firms in LMEs and CMEs develop distinctive strategies and structures to capitalize on the institutions available for market or non-market coordination in the economy." (Hall and Soskice 2001a: 56)

The previous chapters have shown this claim of the competitiveness literature in general, and of the VoC literature in particular to be wrong in two respects.

6.1.1. STRATEGY-DIVERSITY WITHIN THE ECONOMY

Firstly, chapter 1 showed that the competitiveness literature is wrong in suggesting that firms in the same economy specialise in the pursuit of the same competitive strategy (Heckscher 1919: 55-58; Ohlin 1924: 89; Sinn 2005: 18-19; see Porter 1990: 19; 67; Hall and Soskice 2001a: 36-44). On the contrary, firms within the same economy pursue different competitive strategies to the same extent. Accordingly, we found roughly the same percentage of firms in Germany, Italy and the UK to pursue an RPI, a DQP, and – respectively – an LCP strategy. This shows that companies do *not* 'develop distinctive strategies' (Hall and Soskice 2001a: 56) according to the institutional environment in which they are based. Instead, as I argued in chapter 5, firms choose their competitive strategy according to technological opportunities: namely radical or incremental discoveries, or the opportunity for imitation.

But how is my finding that firms in different economies pursue the same varieties of competitive strategies compatible with the claim of the competitiveness literature that production and export patterns differ from one country to another? In essence, two differences in analytical approaches explain this discrepancy. On the one hand, *different proxies are used to measure competitive strategy*. The specialisation argument of the competitiveness literature is essentially based on macro-level analyses which point to differences in the development of entire *industries* (Dalum 1992; Fagerberg 1992; Nelson 1993; Porter 1990: 179-541; Hall and Soskice 2001a: 41-44). In other words, the competitiveness literature uses the technology intensity of *industries* as a proxy for competitive strategies. While it is true that industries differ in their technology intensity, this constitutes a rather crude strategy measure. The reason behind this is that firms which are active in the same industry can differ notably in the extent to which they employ high-tech approaches. In other words, firms in the same industry can pursue different strategies. This is the very reason for which I decided to descend to the micro level and to use the technology intensity of individual *firms* as a proxy for competitive strategy.[129]

On the one hand, *the time-span of empirical observations differs*. While I identified competitive strategies over a time-span of 20 years (see chapter 1: section 1.3.2.), the competitiveness literature shows a tendency for short-term and selective observations which neglect cyclical fluctuations over time (see Porter 1990: 481-541; Hall and Soskice 2001a: 41-44;

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[129] It should be noted that I occasionally relied on (the technology intensity of) industries to measure competitive strategies. Accordingly, I used the biotech industry as a proxy for Radical Product Innovation, whilst I employed the traditional pharmaceutical industry as an indicator for Diversified Quality Production, and the generics industry as a measure for Low Cost Production. However, the quantitative analyses of chapters 2, 3, and 4 revealed that the technology intensity of *firms* constitutes a better measure for competitive strategy than the technology intensity of *industries*, because results turn out to be both stronger and more significant whenever strategies are measured at the company rather than at the industry level.

Casper et al. 1999). Of course, it is tempting to argue that the majority of firms within the same economy pursue a technology-intense strategy because a comparatively large number of firms are active in high-tech industries. Interestingly, however, the competitiveness literature tends to ground this argument on short-term and selective studies which ignore the fact that strong specialisation patterns are often of a temporary nature. While it is true that specific high-tech industries are more developed in some countries than in others, such specialisation patterns are often the result of age differences. That is, industries *started to develop at different points in time*, probably because technological opportunities arose at different moments (see chapter 5: section 5.3.). However, countries lagging behind at a given moment can, and do catch up over time (Freeman 1992: 170-174; see also Freeman 1995). It is therefore risky to ground industry-specialisation arguments on short-term and selective observations (see Porter 1990: 481-541; Hall and Soskice 2001a: 41-44; Casper et al. 1999).

In sum, it depends both on the *level* and the *time-span* of the analysis as to whether strategy-specialisation patterns are found. While the competitiveness literature rightly points out that the extent to which companies in the same economy engage in diverse *industries* differs, it is erroneous to deduce from such observations that '*firms* in [different economies] develop distinctive strategies' (Hall & Soskice 2001: 56). The micro-level and long-term studies on which I ground my research have shown this claim to be wrong.

6.1.2. COMPANY-SIMILARITY BETWEEN ECONOMIES

Secondly, we also found the competitiveness literature wrong in suggesting that "firms are not essentially similar across nations" (Hall and Soskice 2001a: 56). On the contrary, firms which pursue the same strategy in different economies behave strikingly similarly. They not only ground their choice of competitive strategy on the same basic principle, namely technological opportunities (see chapter 5), they also require the same input factors to pursue that chosen strategy (see chapter 2, 3, and 4). Accordingly, we found that Radical Product Innovators require institutional share capital, employees with field-specific skills, and scientists with heterogeneous knowledge. Diversified Quality Producers, by contrast, need private share capital, a workforce with firm-specific skills, and scientists with homogenous knowledge. Low Cost Producers are the least demanding in terms of input factors as their strategy is financed from short-term liabilities, and thus requires neither employees with specific skills nor scientists with particular knowledge. What is more, chapter 3 revealed that companies in different economies also resemble each other in their standardisation policies. Even though standards do not constitute a necessary input factor,

firms in different countries develop and use the same types of standards depending on the competitive strategy they pursue.

Finally, chapters 2, 3, and 4 taught us that firms act in strikingly similar ways whenever it comes to securing necessary input factors. The competitiveness literature in general (Porter 1990: 126-130; Patel and Pavitt 1994: 87-89; Andersen 1992: 69; Sinn 2005: 68; see Ohlin 1933: 52-53), and the VoC literature in particular (Hall and Soskice 2001a: 21-44), rightly point out that national institutions provide just one set of specific input factors. While a private pension and insurance system delivers the institutional share capital required for Radical Product Innovation, this type of finance is comparatively scarce in countries where pension and insurance schemes are administered by the state. Similarly, flexible labour-market institutions mean that employees in general, and scientists in particular acquire the qualifications needed for Radical Product Innovation, while lacking the skills necessary for Diversified Quality Production. The opposite is true for countries with rigid labour markets. Here, employees and scientists tend to have those qualifications which are at the basis of Diversified Quality Production, while they lack those skills required for the pursuit of an RPI strategy. But whenever national institutions do not provide (all) the required input factors, firms in the UK, Germany and Italy are strikingly similar in the extent to which they circumvent national institutions in order to make up for missing factors. In so doing, they demonstrate a remarkable inventiveness which is at odds with the competitiveness literature's perception of firms as mere institution-takers (see section 6.1.4.).

In sum, contrary to Hall and Soskice (Hall and Soskice 2001a: 56), we found that firms *are* essentially similar across nations in three respects: they choose their competitive strategy on the basis of technological opportunities, they require the same input factors for the pursuit of a given strategy, and they inventively compensate for lacking input factors.

That said, I wish to add a note of caution to my present and previous criticism of the competitiveness literature. Contrary to this literature, my findings – that firms in different economies behave in a strikingly similar way, and that the institutional provision of input factors does not impact on their competitive behaviour – are grounded on the study of just one production sector. I have only studied firms active in the pharmaceutical sector and its sub-sectors: biotechnology, traditional pharmaceuticals, and the generics industry. While I hope that the results are transferable to other industries, I am aware that the technology intensity of the pharmaceutical sector constitutes a characteristic which may be peculiar to this particular industry. Thus, I acknowledge that my findings may be particularly, or only relevant for high-tech sectors in general, and for the pharmaceutical sector in particular. However, it must be the task of future research to find out whether the institutional provision of input factors determines

the strategic behaviour of those firms which are active in other, more low-tech sectors (see Heckscher 1919: 56-58; Ohlin 1933: 7; 50-55; Sinn 2005: 18-19; Porter 1990: 67; Hall and Soskice 2001a: 38-41).

6.1.3. Alternative Pathways to Competitiveness

It follows from the above that while firms resemble each other in their manner of competing alternative pathways to competitiveness exist. More precisely, I identified three pathways to international competitiveness through my research project. As illustrated by the competitiveness literature (see Ohlin 1933: 52-53; Sinn 2005: 68; Andersen 1992: 69; Patel and Pavitt 1994: 87-89; Porter 1990: 126-130; Hall and Soskice 2001a: 21-44), the first pathway consists in the provision of input factors *through national institutions*. That is, entrepreneurs simply use those factors which emerge from national financial and labour-market regulations. Accordingly, Radical Product Innovators in flexible labour markets are 'automatically' provided with field-specific employee skills and heterogeneous scientific knowledge. Diversified Quality Producers in rigid labour markets have no difficulties in recruiting a workforce with firm-specific skills, and scientists with homogeneous knowledge. Similarly, firms which pursue an RPI strategy in a private pension and insurance system find it comparatively easy to acquire institutional share capital.

Whenever national institutions do not provide (all) necessary input factors, firms often take the second pathway to competitiveness: they secure the factors they lack *through improvisation on a contractual basis*. In so doing, firms circumvent national institutions – e.g. by simply not installing a works council, or by dropping out of national wage-bargaining agreements. The circumvention of national institutions allows firms to secure alternative input factors in an 'improvisational' way; usually by concluding contracts with other economic actors[130]. Examples of such contractual factor provision are numerous (see chapter 4: sections 4.2.4. and 4.3.3.). To recall just a few, we have seen that Radical Product Innovators in rigid labour markets secure field-specific employee skills through temporary employment contracts. Research projects are outsourced to university researchers; and PhD students as well as recent graduates are employed for a limited time period during which they work on specific projects. Similarly, Radical Product Innovators in rigid labour markets secure scientists with

[130] Of course, a company can only *use* a financial and labour-skill factor after the conclusion of a financing, or respectively an employment contract. However, what is important for a firm's competitive success is not the *use per se*, but the potential availability and, hence, the *provision* of required factors. Accordingly, the second pathway to competitiveness does not refer to how companies *choose* factors among possible alternatives, but to how they *make sure* that the required factors are provided.

heterogeneous knowledge by exposing the latter to numerous stimuli – be it by collaborating closely with other firms, or by encouraging scientists to publish and present their findings at conferences. On the other hand, Diversified Quality Producers in flexible labour markets conclude employment contracts which aim at tying employees to the company so as to provide them with firm-specific skills. This is done by offering long-term pension and insurance schemes to employees, as well as the opportunity of intra-firm promotion and of participating in sophisticated training programs.

The third and, in my view, final pathway to competitiveness consists in the provision of input factors *through importation*. Again, firms circumvent national institutions in that they do not employ those financial means and labour qualifications which are abundantly provided by national financial and labour-market regulations. Instead, firms import the required factors from other economies by drawing on international institutions. For example, companies which pursue an RPI strategy in economies where pensions and insurance schemes are administered by the state often acquire institutional share capital from countries with a private pension and insurance system (see chapter 2: section 2.4.3.). Similarly, Radical Product Innovators in rigid labour markets employ scientists from other countries in order to secure the necessary heterogeneous knowledge base (see chapter 4: section 4.3.3.).

One may argue that the third pathway of 'competitiveness *though importation*' is better described as factor provision *through foreign national institutions*, because firms import those factors that emerge from the pension systems and labour-market institutions of another economy. However, such factor transfer is only possible in open financial and labour markets. Hence, it is international financial and labour-market institutions, rather than foreign national institutions, that enable firms to secure input factors from abroad. The best example of this is provided by the European Community, where the free circulation of capital, goods, services and people has been guaranteed since the Single European Act of 1986. This makes it much easier for Radical Product Innovators to secure heterogeneous scientific skills by employing EU rather than non-EU scientists. Similarly, Radical Product Innovators find it easier to acquire institutional share capital from EU rather than from non-EU investors.

In sum, firms secure input factors in three ways: they use factors provided by national institutions; they secure factors by improvising on a contractual basis; and they import scare factors by drawing on international institutions. Thus, the abovementioned pathways to competitiveness can be summarised as (1) competitiveness through national institutions, (2) competitiveness through improvisation, and (3) competitiveness through importation.

It is interesting to note that the competitiveness literature is somewhat blind towards the second and third pathways to competitiveness. Blindness towards the second pathway is understandable to the extent that *competitiveness through improvisation on a contractual basis* may be too evident to merit systematic attention. However, the literature's blindness towards the third pathway of *competitiveness through importation in line with international institutions* is striking, in that the literature is very concerned with the question of how globalization, or internationalisation impacts on firm competitiveness. Sharing a general understanding of internationalisation as a *decrease in barriers to trade which leads to an increase in flows of goods and capital across national borders* (Hall and Soskice 2001a: 55; Chesnais 1992: 280; see Nelson 1993: 17-18; 518-519; see Porter 1990: 53; see also Sinn 2005: 53), the literature acknowledges that firms can relocate (some of) their facilities to other economies. But why does it ignore the fact that internationalisation also enables firms to procure input factors from other countries? In essence, the reason resides in the explicit (Ohlin 1924: 83; see Heckscher 1919: 48) or implicit (Sinn 2005: 66-68; Chesnais 1992: 280-282; Nelson 1993: 518-519; Porter 1990: 53-58; 67-68; Hall and Soskice 2001a: 56-57) assumption of the competitiveness literature that input factors are immobile between economies. Accordingly, the literature acknowledges that firms can gain competitiveness through relocation (Hall and Soskice 2001a: 56-58; Porter 1990: 55-58; Chesnais 1992: 280-282; Nelson 1993: 518-519; Sinn 2005: 18-19), while the possibility of gaining competitiveness through acquiring input factors from abroad is neglected.

6.1.4. International Competitiveness though Entrepreneurial Creativity

In addition to the insight that various pathways to international competitiveness exist, another noteworthy conclusion regarding the sources of firm competitiveness can be drawn from my research findings. Competitiveness does *not* primarily arise from the mere provision of input factors, but from the inventiveness of entrepreneurs. Let us recall the findings of chapters 2, 3 and 4 that national institutions provide just one set of input factors. Consequently, it is *not* factor provision through national institutions that enables firms to pursue different strategies in different institutional environments (see Ohlin 1933: 52-53; Sinn 2005: 68; Andersen 1992: 69; Patel and Pavitt 1994: 87-89; Porter 1990: 126-130; Hall and Soskice 2001a: 21-44). Instead, we have seen that it is the inventiveness with which entrepreneurs secure all their required factors that allows companies to compete internationally. Hence, firms are competitive as a result of entrepreneurial creativity rather than as a result of national regulation.

But how is it possible that the competitiveness literature ignores the importance of entrepreneurial creativity? In essence, the answer lies in the causal chain that underlies the

reasoning of this literature. Except for the literature on national innovation systems (see Lundvall 1992a: 10-13; Freeman 1995: 10-14; Dalum 1992: 203-207), all other strands argue that national institutions determine the quality and/or price of input factors required for a given strategy (see Ohlin 1933: 52-53; 6; Sinn 2005: 142-143; Porter 1990: 126-130; Hall and Soskice 2001a: 21-44). This direct causal link between *national regulation*, *input factors*, and *competitive strategy* leads to a perception of entrepreneurs as mere institution-takers. While the literature acknowledges that firms can relocate (some of) their facilities to the most favourable institutional environment (Hall and Soskice 2001a: 56-58; Porter 1990: 55-58; Chesnais 1992: 280-282; Nelson 1993: 518-519; Sinn 2005: 18-19), the possibility that firms may circumvent national regulations is ignored. Hence, entrepreneurs are regarded as constrained by national institutions to an extent that leaves no room for entrepreneurial creativity.

This is not the case for the literature on national innovation systems which reasons along the following lines: depending on how national institutions condition processes of interactive learning, different technological opportunities arise (Dalum et al. 1992: 301). The latter translate into different types of innovations which, in turn, are at the basis of different competitive strategies, reflected by differing national patterns of industry specialisation (see Lundvall 1992a: 10-13; Freeman 1995: 10-14; Dalum 1992: 203-207). While national institutions are said to channel competitiveness, the causal chain between *institutions*, *technological opportunities*, *innovation* and *competitive strategy* leaves room for entrepreneurial creativity. The reason for this is that entrepreneurs are perceived as the initiators of this causal process. Pointing to Schumpeter's early work on the theory of economic development, Lundvall writes '(...) [E]ntrepreneurs, who act individually, [are] the most important economic agents bringing innovations into the economic system' (Lundvall 1992a: 9). Accordingly, entrepreneurs are recognised as the main driving force behind any innovation and, hence, behind competitiveness, because *they* decide on which type of institutions they want to draw.

The causal chain explored in the course of this research project is akin to the reasoning of the innovation literature in that it considers entrepreneurial inventiveness as crucial for firm competitiveness. While less concerned with understanding their causes, I identified technological opportunities as the main determinant of a firm's choice of competitive strategy (see chapter 5: section 5.3.). Once this choice is made, entrepreneurs secure all required input factors through national institutions, improvisation, and importation (see section 6.1.3.). In line with the innovation literature, the causal chain between *technological opportunities*, *strategy choice*, *factor provision*, and *strategy pursuit* recognises entrepreneurial creativity as the main driving

force behind firm competitiveness, because entrepreneurs can only embark on their chosen strategy if they succeed in securing all required input factors.

In sum, my findings suggest that entrepreneurs are *less constrained* by national regulations, and *more creative* than assumed by most strands of the competitiveness literature (see Ohlin 1933: 52-53; 6; Sinn 2005: 142-143; Porter 1990: 126-130; Hall and Soskice 2001a: 21-44). Accordingly, I argue that the perception of entrepreneurs as mere institution-takers does not allow us to understand how firms compete in different institutional environments. Instead, I agree with the innovation literature that a Schumpeterian perception of entrepreneurs as inventive creators (see e.g. Schumpeter 1934, chapter 4; Schumpeter 1942: 81-106) is the most instructive approach for understanding firm competitiveness.

6.2. Varieties of Capitalism: Addressing Open Questions

In the previous section, I summarised my research findings and discussed how they speak to the competitiveness literature in general. To date, the literature on 'varieties of capitalism' (VoC) constitutes that strand of the competitiveness literature which proposes the most elaborate arguments about how national institutions condition firms' competitiveness. It is precisely for this reason that I derived many hypotheses on the link between institutions, input factors and competitive strategies from the VoC literature's reasoning. Therefore, my findings not only shed light on the competitiveness literature in general, they also speak to concerns which emerge from the VoC literature in particular. It is the aim of section 6.2. to address three of these concerns.

6.2.1. Institutional Complementarities: A Functionalist Explanation of Institutional Formation

It is one of the central arguments of the VoC literature that *institutions are complementary*. '[T]wo institutions can be said to be complementary if the presence (or efficiency) of one increases the returns from (or efficiency of) the other' (Hall and Soskice 2001a: 17). Hence, the VoC literature proposes a functionalist explanation of institutional development: Institutions in one realm of economic activity are said to assume a definite shape so as to improve the outcome of institutions in another realm of economic activity (Hall and Soskice 2001a: 21-36). It is furthermore important to note that the VoC literature adopts a firm-centered approach in that it 'regards companies as the crucial actors in a capitalist economy' (Hall and Soskice 2001a: 6). Accordingly, the literature perceives the needs of international competitiveness for firms as the main determinant of institutional formation. In sum, the VoC literature suggests that national institutions assume that complementary shape which is most

adequate for supporting international firm competitiveness (Hall and Soskice 2001a: 17-21), because this results in particularly 'satisfactory levels of long-run economic performance' (Hall and Soskice 2001a: 21).

While the functionalist logic of this reasoning may be appealing to institutionalist scholars and government officials, my research findings indicate that the VoC argument on institutional formation in general, and on institutional complementarities in particular, is grounded on two central misconceptions. On the one hand, the VoC literature ignores the existence of functional equivalent institutions. I illustrated in section 6.1.4. that firms are more than mere institution-takers. Whenever national institutions do not provide the input factors firms require to pursue their chosen strategy, entrepreneurs circumvent national institutions and rely on functional equivalents in order to make up for this lack on their own. More precisely, entrepreneurs improvise by concluding contracts which deliver the required factors, or they import the necessary factors from abroad by drawing on international institutions (see section 6.1.3.). Consequently, there is no need for national institutions to assume a complementary shape: why should they if entrepreneurs can use functional equivalents?

On the other hand, the firm-centered approach of the VoC literature is overly narrow. More precisely, the literature seems to be misguided in perceiving firms as 'the crucial actors in a capitalist economy' (Hall and Soskice 2001a: 6), and their interests as the central determinant of institutional formation (Hall and Soskice 2001a: 17-21). Of course, firms constitute an important interest group within a political economy, and their need for competitiveness is of central concern to national policy makers. But firms do not constitute the only lobby within the economy; and policy makers have to take a variety of socio-economic constraints into consideration when issuing new, or reforming existing legislation. It is furthermore likely that firm interests in general, and their suggestions about how to improve competitiveness in particular, are not homogeneous throughout the economy. This is particularly true as we have seen that firms in the same economy pursue different competitive strategies (see chapter 1: section 1.3.2.). In sum, it is implausible that institutional formation is functionalist to the extent that institutions assume those shapes preferred by (all) firms within the economy.

To conclude, my research findings indicate that the functionalist explanation of institutional formation proposed by the VoC scholars falls short in two respects. Not only does it ignore the fact that firms can resort to functional equivalent institutions, it also attributes too much importance to firms and their – allegedly homogeneous – interests for improved competitiveness. Although I do not systematically explore an alternative approach, it seems that a

historical account of institutional development is more instructive for understanding institutional formation than the functionalist logic underlying the VoC reasoning.

6.2.2. CMEs AND LMS: *STATIC* INSTITUTIONAL CONSTELLATIONS ACHIEVING OPTIMAL FIRM COMPETITIVENESS

The idea that institutions are complementary leads the VoC scholars to propose a second argument which is central to their literature. Two *optimal institutional constellations* are identified in which maximum firm competitiveness is achieved (see Hall and Soskice 2001a: 8-9; 14-33; 36-44). More precisely, financial- and labour-market institutions are said to assume an optimal shape if they assume that (complementary) form which facilitates the pursuit of the same competitive strategy. In other words, optimal competitiveness is achieved whenever institutions regulate economic interaction in such a way that firms are provided with all necessary factors for one competitive strategy. Overall, two optimal institutional constellations are identified, namely 'Coordinated Market Economies' (henceforth CMEs), and 'Liberal Market Economies' (henceforth LMEs). In CMEs, financial- and labour-market institutions take forms that provide all the input factors required for the pursuit of a DQP strategy (Hall and Soskice 2001a: 21-27; 36-44). The opposite is true for LMEs, where financial- and labour-market institutions provide all necessary factors for Radical Product Innovation (Hall and Soskice 2001a: 27-33; 36-44).

However, the VoC argument on optimal institutional constellations suffers from one crucial flaw. It simply cannot account for suboptimal institutional constellations (see Hall and Soskice 2001a: 19-21). It cannot explain why financial-market institutions on the one hand, and labour-market institutions on the other, assume shapes which support different competitive strategies. Switzerland constitutes one example of such institutional mismatch. Although the Swiss pension and insurance system contains a strong *private* component, one could argue that it supports a DQP strategy in that its *public* element hampers the provision of institutional share capital. However, the Swiss labour market is highly flexible, thereby facilitating the pursuit of an RPI, rather than a DQP strategy (see Börsch forthcoming). The classification of Switzerland as a CME therefore seems bold (see Hall and Soskice 2001a: 20). Various Mediterranean economies – namely France, Italy, Spain, Portugal, Greece, and Turkey – provide further examples of institutional mismatch. On the one hand, these economies are said to have 'specific kinds of capacities for non-market coordination in the sphere of corporate finance' (Hall and Soskice 2001a: 21) which, in turn, support Diversified Quality Production. On the other hand, they are also said to have 'more liberal arrangements in the sphere of labor relations' (Hall and Soskice 2001a: 21) which are at the basis of Radical Product Innovation. This institutional mismatch makes it impossible for the VoC scholars to classify the Mediterranean economies as either

CMEs or LMEs (see Hall and Soskice 2001a: 21). In sum, the VoC literature is puzzled with the question of why financial- and labour-market institutions in many economies assume a suboptimal shape.

My research findings shed light on this question. They suggest that the identification of (only two) optimal institutional constellations is not very instructive, as it results from an overly narrow focus on national institutions and, consequently, from the neglect of institutional equivalents. I illustrated previously that entrepreneurs do not necessarily employ those factors which are provided by national institutions. Entrepreneurs also circumvent the latter by securing alternative factors through improvising on a contractual basis, or by importing scarce factors from abroad (see section 6.1.3.). In the abovementioned cases of Switzerland and the Mediterranean economies, for example, open financial and labour markets allow firms to import missing financial means and labour qualifications from other countries. Similarly, firms can secure factors by resorting to contractual provisions. However, the exclusive study of national institutions leads the VoC literature to ignore the fact that entrepreneurs can resort to functional equivalents, namely contracts and international institutions. Given the variety of institutions which enable international firm competitiveness, the identification of optimal institutional constellations in general, and the identification of just two optimal constellations in particular, is not fruitful for understanding institutional development on the one hand, and sources of firm competitiveness on the other.

6.2.3. Institutional Adjustment: *Dynamic* Institutional Constellations achieving Optimal Firm Competitiveness

The previous section showed that the VoC literature cannot explain *static* institutional mismatches. In other words, it is puzzled with the question of why national institutions assume suboptimal shapes, given that two optimal institutional constellations are identified (see section 6.2.2.). In a similar vein, the VoC literature wonders about *dynamic* institutional mismatches: what happens if an optimal institutional constellation – be it a CME or an LME – is unsettled by an external shock (Hall and Soskice 2001a: 62-63)? According to the VoC literature '[i]nstitutional complementarities should play an important, if ambiguous, role in these processes of adjustment.' (Hall and Soskice 2001a: 63).

Drawing on their argument about institutional complementarities, the literature identifies two types of institutional adjustment as a response to an external shock. 'On the one hand, (...) institutional reform in one sphere of the economy could snowball into changes in other spheres as well.' (Hall and Soskice 2001a: 63-64). Thus, the first adjustment path consists in the fundamental transformation of the entire institutional regime because a change in one area, say in

financial-market institutions, entails change in another area, i.e. labour-market institutions (Hall and Soskice 2001a: 64). To put it differently, a perfect CME could turn into a perfect LME, and an ideal LME could become an ideal CME. 'On the other hand, institutional complementarities generate disincentives to radical change. Firms and other actors may attempt to preserve arrangements in one sphere of the economy in order to protect complementary institutions or synergies with institutions elsewhere that are of value to them.' (Hall and Soskice 2001a: 64). Accordingly, the second path of adjustment consists in one institution taking a suboptimal shape for a limited period of time, after which it reassumes its original complementary form in order to end the disadvantages resulting from institutional mismatches. So, even though the institutions regulating economic interaction in one area change, the benefits of improved competitiveness resulting from institutional complementarities are so strong that firms will seek to restore the original institutional constellation (Hall and Soskice 2001a: 65).

It might be surprising that these two adjustment paths are opposing in so far as the first path is described as *radical institutional change*, and the second as *institutional readjustment*. It will, however, hardly come as a surprise that the VoC literature leaves open the question as to which path is the more likely response to an external shock (Hall and Soskice 2001a: 62-66). My research findings indicate that the incapacity of the VoC literature to make a clear-cut statement about the outcome of *dynamic* institutional mismatches is essentially grounded on two misconceptions. Firm interests are less central to national policy-making, and less homogeneous throughout the economy, than is assumed by the VoC literature.

I have already argued that whenever contemplating institutional reform, national policy makers definitely take an interest in the opinions and preferences of firms. However, firms do not constitute the only interest group within an economy; and policy makers usually have to consider a variety of socio-economic constraints when deciding institutional reforms. As a matter of fact, the reconciliation of different and often opposing interests is central to national policy-making and legitimises its outcome. It is therefore short-sighted to assume that institutional reform is driven by the predominant concern of policy makers to provide firms with an optimal institutional environment.

But even in those instances in which economic considerations and, hence, firm interests are particularly important to institutional reform, it seems one-sided to assume that the interests of firms are homogenous throughout the economy. Given my finding that firms within the same economy pursue different competitive strategies (see chapter 1: section 1.3.2.), the question arises of to whom policy makers will listen: to Radical Product Innovators, to Diversified Quality Producers, or to Low Cost Producers? We can therefore conclude that the functionalist

explanation proposed by the VoC literature is not very fruitful for understanding institutional reform in general, and institutional adjustment to external shocks in particular.

Indeed, examples of institutional adjustment following the functionalist logic proposed by the VoC scholars are hard to find. One of the most profound reforms of the German corporate governance system in recent years, namely the abolition of capital-gains taxes on the sale of corporate shareholdings in 2001 (see Hall and Soskice 2001a: 61), has not had any noticeable impact on German financial-market organisation on the one hand (see Deutsche Bundesbank 2006: 108; 110), and labour-market regulation on the other. Similarly, it is not clear how the argument that alleged wage-drift in large German companies entails a deterioration of effective wage coordination in some sectors (Hall and Soskice 2001a: 64-65) fits the argument on complementary institutional adjustment. Where is the spillover effect of 'institutional reform in one sphere of the economy [snowballing] into changes in other spheres as well' (Hall and Soskice 2001a: 63-64)? In sum, my finding that firm interests are heterogeneous throughout an economy, and presumably not of predominant concern to national policy makers, suggests that institutional adjustment to external shocks is not driven by a functionalist logic. As with institutional formation (see section 6.2.1.), institutional adjustment to external shocks seems instead to be historically grounded, as it differs from one country to another – depending on the mix of socio-economic constraints to be addressed.

To conclude, my research findings militate against the functionalist explanations of institutional formation and adjustment proposed in the VoC literature. Perceiving financial- and labour-market institutions as complementary, this literature identifies two static institutional constellations, and two dynamic modes of institutional adjustment, which allegedly entail optimal firm competitiveness (Hall and Soskice 2001a). However, my research findings indicate that these arguments are grounded on an overly narrow focus on firms on the one hand, and national institutions on the other. While the former leads the VoC literature to ignore the fact that firm interests do not constitute the main determinant of national policy-making, the latter makes it blind to functionally equivalent institutions. As a result, the argument about institutional complementarities is not particularly instructive for understanding institutional formation on the one hand, and institutional adjustment on the other.

6.3. Lessons to be Learned about Institutional Development

The following and last section of this chapter elaborates on the implications which derive from my research for the development of national institutions. In so doing, I illustrate in section 6.3.1. which conclusions can be drawn regarding the question of how globalisation impacts on

institutional development. Will national institutions converge or diverge over time? Elaborating on the extent to which institutions diverge in shape, but converge in their ever lower impact on entrepreneurial behaviour, I argue that converging divergence is the most likely outcome of institutional development. Section 6.3.2. concludes the chapter by reasoning about the possibilities of national policy makers to design competitiveness-enhancing institutions.

6.3.1. Convergence in Impact on Entrepreneurial Behaviour, Divergence in Shape

It should be borne in mind that the competitiveness literature essentially arose in response to the question of how the increasing internationalisation of economic activity impacts on national institutions. Will internationalisation lead to institutional convergence as national policy makers find themselves obliged to adopt the single best mode of institutional market regulation which enables optimal firm competitiveness (see e.g. Sinn 2003)? Or, will internationalisation lead to institutional divergence because firms can compete in different ways so that several 'good' ways of institutionalising economic interaction exist (see Lundvall 1992b; Nelson 1993; Porter 1990; Hall and Soskice 2001b)?

It will hardly come as a surprise that neo-liberal proponents perceive institutional convergence as the most likely outcome of institutional development under internationalisation (see e.g. Sinn 2003). The reasoning underlying this argument runs along the following lines: given that internationalisation increases competition – as it increases price-transparency due to the removal of international trade barriers – national policy makers will have to deregulate markets in order to enable production at the lowest possible costs. Neo-liberal theory has often been criticised for its one-sided perception of firms as mere production functions (see Williamson 1990: 1-3; Hart 1995: 155; Glenn Thomas 1994: 458-459) which also underlies the reasoning behind the convergence argument. Given that companies are perceived as 'black-box' production functions, all that matters for firm competitiveness from a neo-liberal point of view are the *costs* of production factors. This, in turn, explains the claim on the deregulation of markets, and the convergence of national institutions as a result of increasing internationalisation (see e.g. Sinn 2003).

Contrary to neo-liberal thought, the competitiveness literature acknowledges firms to be an *ensemble* of tangible and intangible assets rather than cost-driven production functions (see e.g. Hall and Soskice 2001b: 17). Consequently, the competitiveness literature recognises that firms not only compete on the basis of costs but also on the basis of quality. Acknowledging the *quality* of production factors as a source of firm competitiveness, the internationalisation of economic activities is said to entail the divergence rather than the convergence of national

institutions – depending on the competitive strategy to be supported. Thus, one of the most important contributions of the competitiveness literature consists in its insight that more than one way of organising economic activity exists which delivers firm competitiveness and, consequently, economic prosperity (see Lundvall 1992b; Nelson 1993; Porter 1990; Hall and Soskice 2001b).

While my research findings are definitely more in line with the divergence argument of the competitiveness literature than with the convergence argument of neo-liberal theory, I discard the functionalist logic underlying the former's reasoning. National institutions do not assume their shapes because they must support a specific competition system. Instead, they take shape in response to a (historically grounded) variety of socio-economic constraints which often differ from one economy to another (see section 6.2.1.). But what can these findings contribute to the debate on institutional development under globalisation? Can we expect national institutions to diverge rather than to converge over time?

My studies of pension and insurance systems, labour markets, and research regimes in the UK, Germany and Italy clearly show that institutions differ in shape. In my view, the reason for these differences stems from the fact that socio-economic problems vary from one economy to another. Depending on the mix and magnitude of these problems, national policy makers adopt different reforms which translate into different ways of institutionalising economic interaction. Labour-market reforms in Italy and the UK since the early 1980s provide telling examples. In aiming to boost employment in order to alleviate the consequences of the two oil crises in the 1970s, the British government deregulated the labour market at the beginning of the 1980s (King and Wood 1999). Italian policy makers, in contrast, have never considered similar labour-market deregulation as it was feared that this would lead to substantial unemployment among older employees. Instead, Italian politicians have preferred since the early 1970s to promote the employment of young graduates by issuing legislative decrees that grant fiscal relief to firms which hire project collaborators for a limited time period (see DPR 597 1973).

Importantly, national politicians can address socio-economic problems through a large variety of institutional reforms, because firm competitiveness does not depend on the provision of input factors through national institutions (see section 6.1.3.). Even if politicians deem it necessary to change institutions which are central to the provision of specific input factors, firm competitiveness is not hampered as entrepreneurs can resort to functional equivalents: they can improvise and secure required factors on a contractual basis; and they can import scarce factors from abroad by drawing on international institutions. From this perspective, it is rather unsurprising that the British government launched a pilot project in 2003 evaluating the adoption

of a professional training system according to the German example. Similarly, it is understandable that the left-wing German government under Chancellor Schroeder introduced important tax incentives to stimulate private pension insurance.

But what do these insights teach us about the impact of internationalisation on institutional development? In essence, I argue that the increasing internationalisation of economic activity influences institutional development in two respects. On the one hand, it entails *divergence in the shape of national institutions*. The reason for this is that both the mix and the magnitude of socio-economic problems are more likely to increase rather than to decrease under globalisation. Developing countries become more and more competitive, (labour) migration increases with the result that the population of a country becomes ever more diverse, while cleavages between the rich (winners) and the poor (losers of internationalisation) are increasingly pronounced. Hence, politicians will need to address these problems through a variety of measures which will presumably translate into increasing institutional diversity. I therefore argue that *national institutions diverge in shape* as a result of internationalisation.

On the other hand, and as a corollary of the first development, national institutions *converge in that they are ever less important as providers of input factors*. As a matter of fact, internationalisation enhances competition in that the abolition of trade barriers increases price-transparency. This obliges entrepreneurs to be ever more competitive, i.e. to secure all required input factors in the most efficient way. Given that internationalisation entails an increasing need for institutional reform, entrepreneurs may find it more efficient *not* to secure necessary input factors through national institutions. Instead, they will, presumably, prefer and/or find it increasingly necessary to circumvent national institutions by securing required factors through improvisation on the one hand, and importation on the other. Increasing internationalisation therefore provides an advantage in that it requires more and more international institutions to be put in place which regulate economic interaction at a supra-national level. Accordingly, I argue that the *convergence of national institutions regarding their impact on entrepreneurial behaviour* is the second outcome of institutional development as a result of increasing internationalisation.

In sum, my research findings indicate that ***converging divergence of national institutions*** is the most likely result of institutional development following internationalisation. It should be noted that my understanding of 'converging divergence' differs from that of Katz and Darbishire (2000) who arrive at the same conclusion in their study of employment systems. Arguing that institutions increasingly diverge within the same economy so that institutional differences between economies decrease (or converge), Katz and Darbishire twice refer to the same feature of institutions, namely their *shape* (Katz and Darbishire 2000: 263-283). My understanding of

'converging divergence' is different in that it refers to two different features of institutions: to their *shape* on the one hand and to their *impact upon entrepreneurial behaviour* on the other. Accordingly, and contrary to Katz and Darbishire, I predict *divergence in shape, and convergence in impact upon entrepreneurial behaviour* to be the most likely outcome of institutional development under globalisation.

6.3.2. Conclusions to be Drawn for National Policy-Making

As a final point, thought shall be given to the conclusions that can be drawn from my research findings for national policy making. How should national institutions ideally be designed in order to achieve maximum firm competitiveness? The first, and perhaps most relieving lesson to be learned, is that *national policy makers **do not need** to deliver a perfect institutional environment to firms*. Let us recall that firm competitiveness does not arise from the mere provision of input factors, but from entrepreneurial inventiveness (see section 6.1.4.). Wherever national institutions fail to provide necessary input factors, entrepreneurs circumvent the former and secure missing factors through improvisation and importation (see section 6.1.3.). Consequently, firm competitiveness is not undermined as long as entrepreneurs can circumvent national institutions and resort to institutional equivalents.

The second, and probably less pleasant conclusion to be drawn is that *national policy makers **cannot** provide firms with a perfect institutional environment*. My analyses have shown the trade-off related to the design of national institutions and their impacts on firm competitiveness. Irrespective of whether research systems and labour-market institutions are rigid or flexible, and irrespective of whether pension and insurance systems are public or private, they only facilitate *one* competitive strategy, as they provide just *one* type of input factors (see chapters 2 and 4). Given the finding that firms within the same economy pursue different strategies (see chapter 1), and given that each strategy requires different input factors (see chapters 2 and 4), national institutions cannot assume an ideal shape. They cannot deliver Radical Product Innovators and Diversified Quality Producers alike with all their required input factors.

Does this mean that *any* research, pension and insurance system, as well as *any* labour-market institution facilitates competitiveness to the same extent? Interestingly, this does not seem to be the case either. As I have argued previously, firm competitiveness is not undermined *as long as entrepreneurs can circumvent national institutions*. Hence, policy makers have leverage over firm competitiveness to the extent that they can design more or less 'elastic' institutions. While I define an *elastic institution* as a national institution which entrepreneurs can circumvent rather easily, *inelastic institutions* are hard to circumvent. To give an example, rigid labour

market institutions such as *powerful works councils* are more elastic if firms only have to introduce them upon a request from their workforce. Yet powerful works councils are less elastic if all firms (of a certain size) are legally obliged to install them. A similar example of an elastic, rigid labour-market institution is a *national wage-bargaining agreement* which leaves it up to firms whether they wish to adhere or not. If adherence is compulsory, the elasticity of national wage-bargaining agreements is reduced.

These examples indicate that although no single model of best-praxis exists national institutions can be more or less competitiveness-enhancing, depending on the ease they allow entrepreneurs to pursue an alternative (i.e. not predominantly facilitated) strategy. The easier it is for entrepreneurs to circumvent national institutions, i.e. the more national institutions are elastic, the more they enhance competitiveness. Thus, policy makers *do* have leverage over firm competitiveness: The challenge consists in striking a balance between institutions which support the existing production regime, while leaving entrepreneurs the necessary 'elasticity' to pursue an alternative strategy.

That said, a word of caution needs to be added regarding the leverage of national policy makers over *initiating* firm competitiveness. Let us remember that a firm's decision to compete by choosing a specific strategy does not depend on the extent to which entrepreneurs can secure required input factors (see chapter 5: section 5.2.). Instead, it results from the active attempts of entrepreneurs to turn technological opportunities into marketable products. In other words, entrepreneurial sprit is at the basis of any competitive strategy and, hence, of firm competitiveness in general (see chapter 5: section 5.3.). Accordingly, the question arises of whether policy makers can foster competitiveness through encouraging entrepreneurial spirit.

Economic development in Southern Italy provides a rather discouraging answer to this question. Given that research, pension and insurance systems, as well as labour-market institutions are homogeneous throughout Italy, it is striking that all Northern-Italian regions are well-developed in terms of GDP *per capita*, whereas most Southern-Italian regions are economically underdeveloped. According to scholars of this phenomenon (Trigilia 1992), one major reason for the chronic economic backwardness of the Italian South is the absence of entrepreneurial spirit in the regions concerned. Since entrepreneurial success in Southern Italy can often be achieved only in collaboration with informal, or even illegal networks, many Southern Italians simply prefer not to engage in independent entrepreneurial activities. Until today, all attempts by Italy's policy makers to boost entrepreneurial spirit in Southern Italy through regulatory initiatives have essentially failed. While my research findings do not provide

any insights into how to foster entrepreneurial spirit, the Italian example indicates that the leverage of politicians is rather limited.

In sum, how can politicians foster firm competitiveness? Hoping not to discourage national policy makers, my studies indicate that possibilities to foster the main *source* of firm competitiveness, namely entrepreneurial spirit, are limited. But as soon as entrepreneurs decide to size a technological opportunity and to turn it into a marketable product, they require specific input factors in order to pursue their chosen strategy. In other words, even though the provision of required input factors is not sufficient, it is a necessary condition for competitiveness. It is at this point that policy makers gain leverage. It is important to note that politicians cannot, and do not need to deliver a *perfect* institutional environment to firms. However, policy makers can design more or less elastic institutions, where the former are more competitiveness-enhancing than the latter. Thus, the challenge related to fostering firm competitiveness consists in striking a balance between institutions which support the existing production regime, while leaving entrepreneurs the necessary 'elasticity' to pursue an alternative strategy.

APPENDIX

I. TECHNICAL APPENDIX

II. QUESTIONNAIRES

I. TECHNICAL APPENDIX

CRITERIA EMPLOYED FOR SAMPLING THE PHID DATABASE

POPULATION: COMPOSITION OF PHID DATABASE (13TH NOVEMBER 2004)

Unit of Analysis

A research project aiming at the development of a pharmaceutical product which has reached at least the stage of preclinical development since 1980.

Number of Units of Analysis

16751 pharmaceutical research projects were included in the PHID database on 13th Nov. 2004.

Geographical Coverage

Research projects carried out in 67 countries were included in the PHID database on 13th November 2004. In that, the number of research projects was large enough and, hence, representative only for 7 countries: France, Germany, Italy, Japan, Switzerland, USA, UK.

Characteristics of Units of Analysis, relevant for Database Sampling (see below)

For each pharmaceutical research project, the following characteristics could be identified:

- *Which* firms and/or public research organisation (i.e. universities and research institutes) did participate in the project in question?
- *At which stage* (preclinical R&D; clinical development phase I; clinical development phase II; clinical development phase III; pre-registration and registration; marketing) did a firm and/or a public research organisation participate in the project in question?
- *Which molecule* (*new chemical entity*, or *known chemical entity*) is at the basis of the research project?

Number of Organisations Included

On 13th November 2004, 3522 firms and public research organisations (had) participated in a pharmaceutical project which was included in the PHID database.

SAMPLE: CRITERIA USED FOR SAMPLING THE PHID DATABASE

Type of Researching Organisation

Only those research projects were considered, which were carried out by firms. Projects carried out by public research organisations (i.e. universities and research institutes) were excluded.

Geographical Coverage

Only those research projects were considered, which were carried out by firms with a head-quarter in the UK, Germany, or Italy.

Identification of Competitive Strategies (For a complete discussion see section 1.3.)

Firms were identified as Radical Product Innovators, Diversified Quality Producers, and Low Cost Producers according to the following criteria:

Radical Product Innovators

Identification of those firms which (had) carried out themselves, or out-licensed a research project based on a new chemical entity.

Diversified Quality Producers

Identification of those firms which (had) carried out themselves, or out-licensed a research project based on a known chemical entity. Furthermore, those firms were identified which had in-licensed a pharmaceutical project at any stage of clinical development.

Low Cost Producers

Identification of those firms which (had) in-licensed a pharmaceutical project at the pre-registration, registration or marketing phase.

SAMPLING BIAS: UNDERREPRESENTATION OF FIRMS IN THE SAMPLE OBTAINED

(Generics) Firms which are not engaged in R&D Activities

Given that the PHID database considers only firms which engage in pharmaceutical research projects, (generics) firms abstaining from R&D activities are not included – unless they specialise in the registration or marketing of innovative pharmaceutical products.

Biotechnology Firms in Germany and Italy

Given that many German biotech firms were founded in the mid 1990s, while most Italian biotech firms were founded around the turn of the millennium, only few German and almost no Italian biotech firm are included, because they had not yet brought a pharmaceutical project beyond the stage of preclinical development on 13th November 2004.

II. QUESTIONNAIRES

COMPETITIVENESS-ENHANCING FACTORS IN THE PHARMACEUTICAL- INDUSTRY

QUESTIONNAIRE FORMULATED IN PREPARATION OF A PHD AT THE EUROPEAN UNIVERSITY INSTITUTE (FLORENCE)

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1. ADDRESS

Firm Name: _____

Address: _____

Interviewee: _____

Tel.-Nr.: _____ Fax : _____

E-Mail: _____ Date: _____

2. EMPLOYEE SKILLS: 2A) SKILL PROFILE OF ALL EMPLOYEES

2.0. FIRM SIZE

1. How many employees ...

- ...does your firm currently (2004) employ: _____ (☐ < 50 ☐ 50 – 500 ☐ > 500)
- ...did your firm employ in 2000: _____ (☐ < 50 ☐ 50 – 500 ☐ > 500)

2. In terms of number of employees per area, how active is your firm in each of the following business areas?

Research:	☐ very active	☐ active	☐ not active at all	(Number of employees working in this area: ____)
Development:	☐ very active	☐ active	☐ not active at all	(Number of employees working in this area: ____)
Production:	☐ very active	☐ active	☐ not active at all	(Number of employees working in this area: ____)
Marketing:	☐ very active	☐ active	☐ not active at all	(Number of employees working in this area: ____)
Sales:	☐ very active	☐ active	☐ not active at all	(Number of employees working in this area: ____)

2.1. TYPE OF SKILLS

1. What percentage of your employees fit into the following educational categories?

Primary education, i.e. *without* vocational training, and *without* a university degree (or a comparable degree of higher education):	% of employees
Secondary education, i.e. *with* a degree in vocational training, but *without* a university degree (or a comparable degree of higher education)	% of employees
Tertiary education, i.e. *with* a university degree (or a comparable degree of higher education):	% of employees

2. Please specify the number of years that an employee works for your firm on average: _____ years

3. What is the average age of your employees? _____ years

2.2. VOCATIONAL TRAINING PROGRAMS FOR APPRENTICES

1. Does your firm offer vocational training programs for apprentices? ☐ Yes ☐ No

- IF NO: 2. Why does your firm not offer vocational training programs for apprentices?

- ☐ Because the firm does not need the types of skills which apprentices acquire during vocational training programs.
- ☐ Because it is difficult to find appropriate apprentices.
- ☐ Because the firm would risk its trained employees being offered work with another firm as soon as training was completed.
- ☐ Because it is too costly or time-consuming to organise and monitor vocational training programs.
- ☐ Because it is easier and cheaper to recruit employees that have been trained by another firm.
- ☐ Because numerous employees, having been trained by *another* firm, apply for a job at *our* firm.
- ☐ Other (please specify): _____

Please go to section *2.3. On-the-job Training*

- IF YES: 2. Please specify which vocational training program(s) your firm offers, i.e. which certificates are awarded to your apprentices upon completion of the respective program(s)? If your firm offers a large number of vocational training programs, please list only the most requested:

_____

_____

3. Why does your firm offer vocational training programs instead of recruiting trained employees from other firms?

- ☐ For *financial reasons*, because apprentices constitute a source of comparatively cheap labour.
- ☐ Out of *necessity*, because training apprentices is the easiest way of securing highly qualified employees.
- ☐ For *reasons of competitiveness*, because O the national training system (such as the German Dual System) O the regional training system O the local training system is so well developed that it would be counterproductive not to make use of it.
- ☐ For *image-reasons*, because firms that take on apprentices have a better reputation than firms that do not do so.
- ☐ For *traditional reasons*, because the firm has always been concerned about the education of its employees.
- ☐ For *reasons of competition*, because most of our competitors offer vocational training programs.
- ☐ For *legal reasons*, because vocational training is required by law.
- ☐ Out of *obligation*, because vocational training is required by O a chamber of commerce and industry. O a business association.
- ☐ *Other* (please specify): _____

4. What measures does your firm take to ensure that, once vocational training is completed, employees are not poached by a competitor? _____

_____

5. On completion of a vocational training program, do your employees receive a diploma which is

- ☐ recognised only by your *firm*.
- ☐ recognised throughout the *industry*, i.e. by the majority of (British) firms that are active in the biotechnology, pharmaceutical or generics industry.
- ☐ recognised throughout the *country*, i.e. by the majority of all (British) firms, even if they are not active in the biotechnology, pharmaceutical or generics industry.

6. Who designs and monitors the vocational training programs which are offered by your firm? _____

7. On average, how many apprentices does your firm employ each year? _____ apprentices

2.3. ON-THE-JOB TRAINING

1. Apart from vocational training programs, does your firm offer on-the-job training to its employees, e.g. computer courses, courses on communication or sales-techniques (etc.)?
☐ Yes ☐ No

- IF NO: 2. Why does your firm not offer on-the-job training to its employees?
- ☐ Because all employees are sufficiently skilled in their jobs.
- ☐ Because it is too costly or time-consuming to organise and monitor on-the-job training courses.
- ☐ Because employees are not interested in participating in such courses.
- ☐ Other (please specify): _____

Please go to section *2.4. Salaries and Wages*

- IF YES: 2. Please specify which on-the-job training courses are offered to your employees:
- ☐ Mandatory courses for new employees, e.g. an introductory course to the firm
- ☐ Courses on the organisation, functioning or culture of the firm
- ☐ Courses to prepare employees for promotion, e.g. training programs for (future) managers
- ☐ Vocational retraining courses
- ☐ Courses on the use of special technologies, techniques, tools, or machines, e.g. courses in molecular biology/ cell cultures
- ☐ Courses on certain business functions, e.g. courses in finance or sales, or legal training on GMP requirements
- ☐ Personal development courses, e.g. courses on presentation skills, or courses on project- or change-management
- ☐ Computer or software courses
- ☐ Foreign language courses
- ☐ Other (please specify): _____

3. Please rank the various on-the-job training courses in order of their importance by assigning
- '1' to the type of courses which your employees visit most frequently,
- '2' to the type of courses which your employees visit second most frequently,
- '3' to the type of courses which your employees visit third most frequently.
- ___ Mandatory courses for new employees, e.g. an introductory course to the firm
- ___ Courses on the organisation, functioning or culture of the firm
- ___ Courses to prepare employees for promotion, e.g. training programs for (future) managers
- ___ Vocational retraining courses
- ___ Courses on the use of special technologies, techniques, tools, or machines, e.g. courses in molecular biology/ cell cultures
- ___ Courses on certain business functions, e.g. courses in finance or sales, or legal training on GMP requirements
- ___ Personal development courses, e.g. courses on presentation skills, or courses on project- or change-management
- ___ Computer or software courses
- ___ Foreign language courses
- ___ Other (please specify): _____

4. Please specify whether
- ☐ your firm offers the majority of on-the-job training courses itself.
- ☐ the majority of on-the-job training courses is offered in cooperation with a public body (e.g. a CCI).
- ☐ the majority of on-the-job training courses is offered in collaboration with other firms.
- ☐ the majority of on-the-job training courses is outsourced to external trainers.

5. Are the skills which your employees acquire by participating in on-the-job training courses mostly:
- ☐ ***firm-specific***, i.e. the acquired skills are of use mainly in the context of your firm.
- ☐ ***industry-specific***, i.e. the acquired skills are of use in other (British) firms that are active in the biotechnology, pharmaceutical or generics industry.
- ☐ ***general***, i.e. the acquired skills are of use in any (British) firm, including those that are not active in the biotechnology, pharmaceutical or generics industry.

6. On average, how many employees participate in at least one on-the-job training course per year? _____ employees

7. Why does your firm offer the possibility to participate in on-the-job training courses?

☐ For *reasons of competitiveness*, because on-the-job training increases employee performance.
☐ Out of *necessity*, because on-the-job training is crucial in order to teach employees very specific skills.
☐ For *image-reasons*, because firms that offer on-the-job training have a better reputation than firms that do not do so.
☐ For *traditional reasons*, because the firm has always been concerned about its employees' skills.
☐ For *reasons of competition*, because most competitors offer on-the-job training.
☐ For *legal reasons*, because on-the-job training is required by law.
☐ Out of *obligation*, because on-the-job training is required by O a chamber of commerce and industry.
O a business association.
☐ *Other* (please specify): _____

2.4. SALARIES AND WAGES

1. According to you, how important are trade unions for your firm, considering that they determine standard wages/salaries?

☐	important	☐	rather important	☐	neither important nor trivial	☐	rather trivial	☐	trivial

Why? _____

2. In 2003, how many of your employees were a member of a trade union? ____ % of employees

3. Does your firm participate in market surveys in order to determine the wage-/salary-profile of each job required in the pharmaceutical industry? ☐ Yes ☐ No

4. On average, are your employees paid:

☐ below average wages/salaries? Why? _____
☐ standard average wages/salaries? Why? _____
☐ above average wages/salaries? Why? _____

2.5. WORKS COUNCIL/ EMPLOYEE REPRESENTATIVE

1. Is the majority of your employees paid for working overtime hours? ☐ Yes ☐ No
If necessary, please specify which type of employees is paid overtime hours (i.e. those employees working according to the provisions of a collective pay agreement): _____
_____

2. Does your firm have a works council, or (an) employee representative(s)?

☐ No ☐ Yes, ☐ a works council
☐ ____ employee representative(s)

- IF NO: 3. Why not?_____
Please go to section *2.6. Labour Market Flexibility*

- IF YES:3. Do you consider it

☐	very advantageous	☐	advantageous	☐	neither advantageous nor disadvantageous	☐	disadvantageous	☐	very disadvantageous

for the firm's *employers* that the concerns of the firm's employees are represented by a works council, or respectively by an employee representative(s)? Why?_____

2.6. LABOUR MARKET FLEXIBILITY

1. Does the majority of your firm's employment contracts contain a competition clause?
☐ Yes☐ No

- IF NO: 2. Why not?_____
Please go to question 4

- IF YES: 2. How long is the average period during which an employee is not allowed to work for a competitor when his/her employment relationship with your firm ends? __ weeks/months

3. Do you consider competition clauses as

☐	significant	☐	fairly significant	☐	neither significant nor insignificant	☐	fairly Insignificant	☐	insignificant

obstacle whenever an employee looks for a new job? Why?_____

4.To be asked. Does it occur ☐ very often ☐ often ☐ sometimes ☐ rarely ☐ never that the firms which are active in your industry recruit employees of their competitors?

To be filled in:
(a. Does it occur ☐ very often ☐ often ☐ sometimes ☐ rarely ☐ never that a competitor recruits *a few* of your employees?

b. Does it occur ☐ very often ☐ often ☐ sometimes ☐ rarely ☐ never that a competitor recruits *a considerable number* of your employees?

c. Does it occur ☐ very often ☐ often ☐ sometimes ☐ rarely ☐ never that your firm recruits a few of your competitor(s)' employees?

d. Does it occur ☐ very often ☐ often ☐ sometimes ☐ rarely ☐ never that your firm recruits *a considerable number* of your competitor(s)' employees?)

5. If mutual 'poaching' happens *sometimes*, *rarely* or *never*, what mechanisms prevent this?

_____

6a. What percentage of your employees have- an employment contract of limited duration: __ %
- an employment contract of unlimited duration: __ %

6b. What percentage of your employees with an employment contract of *unlimited* duration work - full-time: _____ %
- part-time: _____ %

7. How long is the average notice period that your firm must respect when employees are dismissed as the result of an economic downturn (if necessary, please specify for different groups of employees)?
☐ Notice periods are negotiated on an individual basis. In most cases, they amount to ____ days/ weeks/ months.
☐ The statutary notice periods apply, which (depending on the employee's seniority) amount to at least ___ days/ weeks/ months.

8. Do you consider these notice periods as
☐ too long? Why?_____
☐ about right? Why?_____
☐ too short? Why?_____

2B) SKILL PROFILE OF SCIENTISTS

1. Of all scientists who work for your firm in the field of R&D, **(100 %)**

- how many are employed by your firm: _____ %
- how many are employed by another organisation: _____ %

namely:
- a university: _____ %
- a O public O private research institute: _____ %
- another firm: _____ %
- another organisation (please specify): _____ : _____ %

2. From how many different *universities* do the scientists working for your firm in the field of R&D come?*
From ___ different universities, of which ca. _____ % are universities in the UK.

3. From how many different *disciplines* do the scientists working for your firm in the field of R&D come?*
From ___ different disciplines, most importantly _____

4. From how many different *countries* do the scientists working for your firm in the field of R&D come?*
From ___ different countries. Apart from the UK (____%), scientists are mostly from _____
_____

5. How would you describe the overall knowledge of the scientists working for your firm in the field of R&D?*

☐	heterogeneous	☐	rather heterogeneous	☐	neither heterogeneous nor homogeneous	☐	rather homogeneous	☐	homogenous

6. Considering the extent of their overall knowledge, how would you describe the collaboration between the scientists working for your firm in the field of R&D?

☐	discordant	☐	rather discordant	☐	neither discordant nor concordant	☐	rather concordant	☐	concordant

7. How would you describe the results delivered by the scientists working for your firm in the field of R&D?*

radically new		incrementally new				conventional
☐	☐	☐	☐	☐	☐	☐
discovery			improvement			imitation
☐	☐	☐	☐	☐	☐	☐

8. Does your firm pay a bonus to scientists who achieve outstanding results in the field of R&D, e.g. by making or contributing to a major innovation?* ☐ Yes ☐ No

- **IF NO: 9. Why not?** _____

- **IF YES: 9. Is the possibility of rewarding an outstanding R&D performance with a bonus stipulated in the majority of employment contracts of those scientists working for your firm in the field of R&D?*** ☐ Yes ☐ No

10. Please specify the last occasion on which scientists were awarded a bonus for their outstanding performance in the field of R&D:

Year: _____ Bonus amount: _____
Rewarded for: _____

* Please consider both the scientists employed by your firm, and the scientists who work for your firm but are employed by another organisation.

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QUESTIONNAIRE FORMULATED IN PREPARATION OF A PHD AT THE EUROPEAN UNIVERSITY INSTITUTE (FLORENCE)

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I - 50016 San Domenico di Fiesole	Web-Site: http://www.iue.it

1. ADDRESS

Firm Name .....

Interviewee .....

Tel.-Nr. ..... E-Mail .....

3. FINANCIAL STRUCTURE

3.1. OVERVIEW

1. What accounting principles does your firm use?

☐ IAS ☐ US-GAAP

☐ HGB ☐ Other (please specify): _____

2. What financial sources did your firm use between 2001 and 2003?*

In Million €uros, or %	2001	2002	2003
a. Share capital, defined as the sum of:			
Issued share capital (or *called-up share capital*) (= Common Stock + Preferred Stock- Treasury Stock)			
+ Capital surplus			
b. Long-term debt (or *loans*)			
c. Retained earnings (or *reserves*)			
Net assets			
d. Cash Flow			
Depreciation			
Subsidies			

*According to US-GAAP

3.2. SHARE CAPITAL

1. How is your firm's executive board (or management) appointed?

☐ Shareholders directly elect the executive board (management).

☐ Shareholders elect a supervisory board which, in turn, elects the executive board (management)

☐ Other (please specify): _____

2. In which ways do your firm's shareholders participate in corporate affairs?

_____

_____

3. Does your firm have a supervisory board? ☐ Yes ☐ No

- IF NO: Please go to question 6

- IF YES: 4. In the course of the last three years, has any person been a member of both the executive board (management) and the supervisory board? ☐ Yes ☐ No (☐ because this is forbidden by law)

5. How do the firm's supervisory board members exert control over the firm's executive board (management)?_____

_____

6. How often does the firm's *executive board (management)* and the firm's *supervisory board* (or the *shareholders* - in the case that no supervisory board exists) meet on average per year?

☐ Once a year ☐ Once every 6 months ☐ Once every 3 months
☐ Once every 2 months ☐ Once a month ☐ More than once a month

7. Do you consider it

☐	crucial	☐	fairly crucial	☐	neither crucial nor trivial	☐	fairly trivial	☐	trivial

for the firm's success that the *supervisory board* (or the *shareholders* - in the case that no supervisory board exists) consults the *executive board (management)* on major corporate affairs?
Why?_____

8. How would you characterise the relationship between the firm's *executive board (management)* and the firm's *supervisory board* (or the *shareholders* - in the case that no supervisory board exists)?

			neutral			
cooperative	☐	☐	☐	☐	☐	uncooperative
trustful	☐	☐	☐	☐	☐	distrustful
friendly	☐	☐	☐	☐	☐	hostile

9. How were your firm's shares spread between private and institutional shareholders between 2001 and 2003?

	2001	2002	2003
Share capital, defined as the sum of 'issued share capital' and 'capital surplus' (see question 3.1.2.)	100 %	100 %	100 %
Private shareholders - Management - Employees - Business Angels - Private Investors - Other (please specify):	%	%	%
Institutional shareholders - Venture Capital - Banks - Funds/ Insurances - Other firms - State - Other (please specify):	%	%	%

10. Do your firm's shareholders include any institutional investors who exert proxy voting rights? ☐ Yes ☐ No

11. How would you characterise the present distribution of your firm's paid-in share capital?

☐	highly	☐	dispersed	☐	neither dispersed	☐	concentrated	☐	highly
	dispersed				nor concentrated				concentrated

12 What sources of information do your *five most important shareholders* mostly consult in order to learn about the firm's performance?

☐ Publicly available accounting indicators, such as the firm's share price or its annual report.
☐ (Reports on) meetings of the supervisory board and the executive board (management).
☐ Direct consultation of the executive board (management).
☐ Other sources of information:_____

3.3. DEBT FINANCE

1. How would you characterise the relationship between the firm's *executive board* (management) and its *creditors* (i.e. banks)?

			neutral			
cooperative	☐	☐	☐	☐	☐	uncooperative
trustful	☐	☐	☐	☐	☐	distrustful
friendly	☐	☐	☐	☐	☐	hostile

2. How difficult is it for your firm to obtain a loan from a bank?

☐	difficult	☐	fairly difficult	☐	neither difficult	☐	fairly easy	☐	easy
					nor easy				

Why?_____

3.4. STATE SUBSIDIES

1. Has your firm been granted any state subsidies over the last 10 years? ☐ Yes ☐ No

- <u>IF YES</u>: 2. On which conditions? Please specify the time period, the awarding institution, and the form of subsidy:

_____

Thank you very much for your assistance!

COMPETITIVENESS-ENHANCING FACTORS IN THE PHARMACEUTICAL- INDUSTRY

QUESTIONNAIRE FORMULATED IN PREPARATION OF A PHD AT THE EUROPEAN UNIVERSITY INSTITUTE (FLORENCE)

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1. ADDRESS

Firm Name

Interviewee

Tel.-Nr. E-Mail

4. STANDARDS AND SPECIFICATIONS

The legislation concerning the quality-standards that manufacturers of pharmaceutical products have to meet is very demanding. In point 33 the European directive 2004/27/EC of 31st March 2004 stipulates that only those active substances "which have been manufactured in accordance with the detailed guidelines on good manufacturing praxis for starting materials" shall be used as starting materials. Among the requirements stemming from the guidelines of good manufacturing praxis, the quality-standards of active and excipient pharmaceutical ingredients, described in so-called 'specifications', play an important role. The Pharmacopoeia is one collection of such recognised 'quality-standards'. Accordingly, the monographs in the Pharmacopoeia meticulously define specifications for active and excipient ingredients. Yet, a manufacturer of pharmaceutical products remains free to define its own specifications.

The following questions refer to the specifications of those active and excipient ingredients that your firm uses as starting materials in the manufacturing of pharmaceutical products.

4.1. TYPE OF AND MOTIVES FOR SPECIFICATIONS OF STARTING MATERIALS

1. Of all the active and excipient ingredients that your firm uses in producing pharmaceutical products, what percentage of these substances are based

- on specifications defined in the Pharmacopoeia: ca. ____ %
- on individual specifications which are not defined in the Pharmacopoeia: ca. ____ %

If your firm uses exclusively active and excipient ingredients whose specifications correspond exactly to those defined in the Pharmacopoeia, please go to question 4.1.5.

2. Let us focus on the active and excipient ingredients - used by your firm - which are based on *individual specifications* (i.e. on specifications which are *not* defined in the Pharmacopoeia).

What percentage of these individual specifications are patent-protected?* About. ____ %

* Consider all individual specifications used by your firm as the new 100%

3. Let us again focus on the active and excipient ingredients - used by your firm - which are based on *individual specifications* (i.e. on specifications which are *not* defined in the Pharmacopoeia).* What percentage of these ingredients are based on individual specifications because the Pharmacopoeia

- does not contain a monograph on the respective active-/excipient ingredient	ca. ..... %
- contains a monograph on the respective active-/excipient ingredient but, for various reasons, your firm has decided to use an alternative specification	ca. ..... %

* Consider all individual specifications used by your firm as 100%

If your firm uses *individual specifications* only because the Pharmacopoeia does *not* contain a monograph on the respective active-/excipient ingredient, please go to question 4.1.5.

4. For what reasons does your firm use *individual specifications* (i.e. on specifications which are *not* defined in the Pharmacopoeia) *although* a Pharmacopoeia-specification exists?

5. Why does your firm (only) use active-/excipient-ingredients whose specifications are defined in the Pharmacopoeia?

☐ Because these specifications can be delivered by many suppliers. This guarantees comparatively low purchase prices, because suppliers cannot keep prices 'artificially' high.

☐ Because both the Pharmacopoeia requirements regarding the ingredient and the GMP-requirements regarding its supplier(s) are clearly defined. This facilitates the procedure when our firm has to audit the supplier(s).

☐ Other (please specify):

4.2. Elaboration of Specifications for Active-/Excipient- Ingredients

Elaboration of Exclusive Specifications

The term *exclusive specification* refers to those specifications of active-/excipient- ingredients, be they patent-protected or not, which can only be accessed and used by your firm or by a very small number of firms/ organisations.

1. Does your firm use active-/exipient ingredients based on exclusive specifications?

☐ Yes ☐ No

If not, please go to question 4.2.4.

2. How are/were the exclusive specifications that your firm uses in the manufacture of pharmaceutical products developed?

☐	By your firm alone.	This assertion applies to ..... % of all exclusive specifications used.
☐	By your firm in cooperation with ***1 other*** firm/ research institute.	This assertion applies to ..... % of all exclusive specifications used.
☐	By your firm in cooperation with ***several other*** firms/ research institutes.	This assertion applies to ..... % of all exclusive specifications used.
☐	Other:	This assertion applies to ..... % of all exclusive specifications used.

If all exclusive specifications that your firm uses have been developed by your firm alone, please go to question 4.2.4.

3. If your firm (has) cooperates(ed) with other firms/ research institutes to elaborate exclusive specifications, please specify...

	Specification 1	Specification 2	Specification 3
- ...whether the cooperation(s) in question are/ were formal (i.e. based on a contract) or informal (i.e. not based on a contract)	☐ formal ☐ informal	☐ formal ☐ informal	☐ formal ☐ informal
- ...whether all participating firms/ research institutes have/had the same authority over how the specifications are/were defined:	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No

ELABORATION OF INCLUSIVE SPECIFICATIONS

The term *inclusive specification* refers to the specifications of active-/excipient- ingredients which can be accessed and used by all interested firms.

4. Are any of your firm's employees members of expert committees or working groups

- in the Pharmacopoeia commission ☐ No ☐ Yes , namely ____ employees

- in any other organisation that elaborates inclusive specifications for active-/excipient-ingredients, such as e.g. the German Pharmaceutical Codex ☐ No ☐ Yes , namely ____ employees

➔ Where applicable, please specify the name of the organisation(s):

____

4.3. RELATIONSHIPS WITH SUPPLIERS OF ACTIVE-/EXCIPIENT- INGREDIENTS

1. For how many years do your 3 most important suppliers of active-/excipient ingredients work for your firm?**Most important supplier: for ____ years

2nd most important supplier: for ____ years

3rd most important supplier: for ____ years

2. For how many years do suppliers of active-/excipient ingredients work for your firm on average?

☐ Less than 1 year ☐ 1-2 years ☐ 2-3 years ☐ 3-5 years ☐ 5-7 years
☐ 7-10 years ☐ 11-15 years ☐ 15-20 years ☐ more than 20 years

3. How would you describe the relationship between your firm and its five major suppliers of active-/ excipient ingredients? **

			neutral			
cooperative	☐	☐	☐	☐	☐	uncooperative
trustful	☐	☐	☐	☐	☐	distrustful
friendly	☐	☐	☐	☐	☐	hostile

Thank you very much for your assistance!

** The importance of a supplier is determined by the annually invoiced amount of money. Accordingly, the supplier that delivers active-/excipient- ingredients for the highest invoiced amount (on average per year) is your firm's most important supplier.

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